SECTION 14
TOTAL QUALITY MANAGEMENT

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GENERAL INTRODUCTION

In the past 10 or 20 years a few companies have radically transformed their business performance. Many of the concepts and methods they have used are now collectively called "total quality" or "total quality management." Many other terms have also been used. These include "business transformation, performance excellence, business excellence, and six sigma." The successes of these companies have dramatically changed how they and others see both quality and business management today. They are rethinking how they are organized, how they manage themselves, and even what businesses they should be in.

INTRODUCTION TO TOTAL QUALITY MANAGEMENT

In the past two decades many organizations throughout the world have been under tremendous pressure. Some have been battered by international competition, others by new entrepreneurial companies that redefined businesses, and yet others were seriously challenged by new technologies which created formidable alternatives to their products and services. Some leading companies have changed rapidly. While some of the new companies have now become major players, other companies are still engaged in daily battles for survival, and many other companies have disappeared.

Many companies have found that all of their radical restructuring, reengineering, downsizing, and numerous quality programs may have helped them survive, but they still do not have a distinctive quality advantage. Their future will be determined by three key areas: alignment, linkage, and replication. Combined with the fundamental concepts of quality management (continuous improvement, customer focus, and the value of every member of the organization), their work in these three key areas is transforming the way they are managing the entire organization.

During these years there has been an increasing global emphasis on quality management. In global competitive markets, *quality* has become the most important single factor for success. Quality management has become the competitive issue for many organizations. Juran has gone so far as to state that, "Just as the twentieth century was the century of productivity, the twenty-first century will be the quality century."

Reimann (1992*a*), then Director for Quality Programs, National Institute of Standards and Technology, U.S. Department of Commerce, in testimony to the U.S. Congress, stated this clearly, "There is now far clearer perception that quality is central to company competitiveness and to national competitiveness."

In the United States, the President and the Secretary of Commerce have given their personal support and attention to quality, thus elevating quality on the national agenda. Their efforts have helped the American public understand that quality is a main component in national competitiveness. In other countries, such as Argentina, Brazil, France, Greece, Malaysia, Mexico, and Singapore, there has also been leadership from the top levels of government and business, creating national programs of awareness, training, and awards.

In October 1991 a leading international business magazine, *Business Week,* published a bonus issue devoted entirely to the subject of quality. The editor-in-chief, Stephen Shepard, called this bonus issue "the most ambitious single project" in *Business Week*'s 62-year history. Shepard further commented that quality "may be the biggest competitive issue of the late twentieth and early twenty-first centuries."

This issue was sold out in a matter of days. The demand was so high in the United States and throughout the world that *Business Week* had to make two additional printings of tens of thousands of magazines. At the end of the year, the magazine editors of the United States named this issue the "Magazine of the Year," the top honor for magazines in the United States.

During 1991, the U.S. General Accounting Office (GAO) completed a study of Malcolm Baldrige National Quality Award winners and site-visited companies. The GAO studied carefully the relationship between quality management activity and success and profitability. This report, GAO Report 91-190, became GAO's all-time best selling report. In early 1995 the National Institute of Standards and Technology of the U.S. Department of Commerce issued a new report contrasting the stock market success of the Malcolm Baldrige National Quality Award–winning companies (companies with divisional winners and site-visited companies) with average companies. The results were convincing. The National Quality Award Program in the United States does not maintain information on an individual organization's financial results, but for the fourth year in a row a special stock comparison study has shown significant differences (Port 1998). The Malcolm Baldrige National Quality Award recipients as a group have outperformed the Standard & Poor 500 by nearly a 2.5 to 1 margin (see Figure 14.1). The recipients achieved a 362-percent rate of growth versus a 148-percent rate of growth for average companies (Port 1998, p. 113).

In Europe, the creation of the European Foundation for Quality Management in 1988 has already had a significant impact on the understanding of quality management as a leadership issue and as a competitive tool. The introduction in 1992 of the European Quality Award has had a major impact in raising senior executive awareness and understanding of quality management concepts and methods. The oldest award is, of course, the Deming Application Prize, which was started in 1951 by the Union of Japanese Scientists and Engineers (JUSE). This prize stimulated the adoption of quality control in virtually every sector of Japanese industry. Over time the prize criteria evolved into the concept of company-wide quality control (CWQC) and total quality control (TQC) (Kondo, Kume, and Schimizu 1995, p. 4).

We should mention here that we will use the generic term "total quality management" to mean the vast collection of philosophies, concepts, methods, and tools now being used throughout the
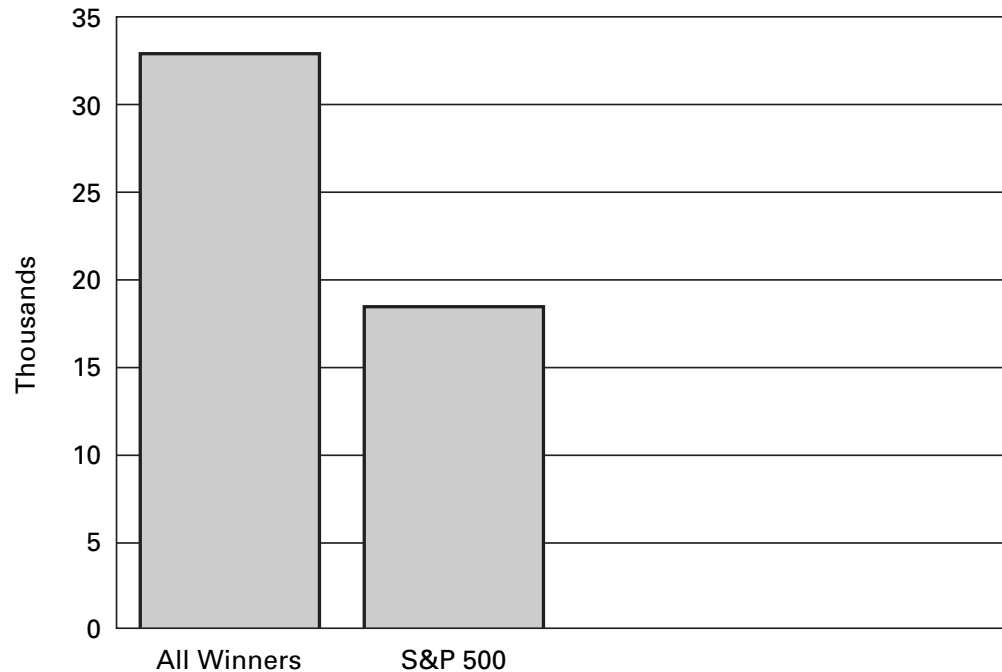
FIGURE 14.1   Corporate growth of investment of $7496.54 in MBNQA winners versus the S&P 500. (*Port 1998, p. 113.*)

world to manage quality. Other terms are frequently used. Total quality management (TQM) is probably the most frequently used term in the United States, while total quality control (TQC) was until recently most often used in Japan, although this may be changing. "The term TQC (total quality control) has begun to be replaced in Japan by the term TQM (total quality management)" (Kondo 1995, p. vi). Kondo himself uses the equivalent term "Companywide Quality Management" in his recent book (Kondo 1995). Another term sometimes encountered is "continuous quality improvement" (CQI). In 1997, JUSE announced a formal change from the term TQC (total quality control) to TQM (total quality management) (The TQM Committee 1997*a,* p. 1). This name change was made both to adopt a more internationally accepted term and to provide an opportunity to revisit the origin of quality control and rebuild the concept to meet new environmental challenges in business management. The TQM Committee of JUSE explained this change in four publications (The TQM Committee 1997*a,* 1997*b,* 1997*c,* and 1997*d*). A summary of their thinking is provided by the diagram in Figure 14.2.

In JUSE's view, TQM is a management approach that strives for the following in any business environment:

- Under strong top-management leadership, establish clear mid- and long-term vision and strategies.
- Properly utilize the concepts, values, and scientific methods of TQM.
- Regard human resources and information as vital organizational infrastructures.
- Under an appropriate management system, effectively operate a quality assurance system and other cross-functional management systems such as cost, delivery, environment, and safety.
- Supported by fundamental organizational powers, such as core technology, speed, and vitality, ensure sound relationships with customers, employees, society, suppliers, and stockholders.
- Continuously realize corporate objectives in the form of achieving an organization's mission, building an organization with a respectable presence, and continuously securing profits.

In any discussion of total quality it is useful to start with the basics: the results we expect, the three fundamental concepts, the three strong forces, the three critical processes, and the key elements of the total quality infrastructure.

(10) Realization of Corporate
        Objectives

    Attainment of Mission
    Building Respectable Presence
    Securing Profits

(1)   Vision, Strategy,
        Leadership

(9a)
Core
Technology
Speed
Vitality

From the Customer's
Viewpoint
Quest for Quality

(9b) Customer Relations
        Employee Relations
        Social Relations
        Supplier Relations
        Stockholder Relations

(6)   Management   System

(7)   Quality
        Assurance
        System

(8) Cross-Functional
    Management
    Systems

Control and Improvement

(4)   Human
        Resources

(5)   Information

(2)   Concepts, Values   (3)   Scientific Methods

Business Environment

FIGURE 14.2   The overall picture of TQM. *The TQM Committee 1997a, p. 4.)*

The Results of Total Quality.   The almost universally accepted goals of total quality are lower costs, higher revenues, delighted customers, and empowered employees. These goals need little explanation. Figure 14.3 from Juran Institute's *Leadership for the Quality Century* workshop graphically illustrates this.

In the past few years we have moved quickly from believing that managing quality just means conformance to specifications and requirements. Quality also means meeting and even exceeding the needs and expectations of customers. Quality includes having the right features, correct documentation, and error-free invoices. It also includes the proper functioning of critical business processes—on-time delivery, friendly and accurate technical support, *and* no failures. Quality involves reducing all the costs of poor quality.

Lower Costs.   Higher quality can mean lowering costs by reducing errors, reducing rework, and reducing non-value-added work. In the past 15 or 20 years companies around the world have repeat-

edly demonstrated that higher quality frequently means lower costs. The costs associated with preventing errors during design are often far less than correcting the errors during production, the costs of preventing errors during production are far less than correcting the errors after final inspection, and the costs of finding and correcting errors during final inspection are far less than fixing the errors after the customer has received the goods or services. Our understanding of these costs has grown rapidly in the past decade (Godfrey 1998, p. 18). Sörqvist (1998, pp. 36–39) defines these costs in five basic categories: traditional poor-quality costs, hidden poor-quality costs, lost income, customers' costs, and socioeconomic costs. See Section 8 for a more detailed discussion of quality and costs. See Section 7 for a discussion of quality and income.

Higher Revenues.   Higher quality can mean better satisfied customers, increased market share, improved customer retention, more loyal customers, and even premium prices. Customers are increasingly beginning to expect and demand high-quality goods and services. By exceeding the levels of quality offered by competitors in the marketplace, organizations can add new customers, retain old customers, and move into new markets. Often, informed customers are willing to pay a price premium for higher levels of quality that provide new and useful features or that reduce total life-cycle costs.

Delighted Customers.   "Delighted" customers are customers who buy over and over again, customers who advertise your goods and services for you, customers who check you first when they are going to buy anything else to see if you also offer those goods or services. Loyal customers will frequently increase their purchases to the point of selecting sole suppliers for certain goods and services (Reichheld 1996).

Market studies have recently shown the dramatic impact of such delighted customers. In one study, customers giving satisfaction ratings of 5 (on a 1 to 5 scale) were 4 times less likely to leave during the next 12 months and 5 times as likely to purchase additional services than those giving satisfaction ratings of 4. In fact, those giving ratings of 2, 3, and 4 were remarkably similar, basically neutral.

Empowered Employees.   For many years organizations viewed empowered employees as a means for achieving lower costs, higher revenues, and delighted customers. Now most leading organizations realize that creating such employees is also a major goal of total quality management. These organizations not only aim to solve the problems of today, but they also want to create an organization that can solve, or even avoid, the problems of tomorrow.

The concept of empowered employees embraces many new ideas. Empowered employees are in self-control. They have the means to measure the quality of their own work processes, to interpret the measurements, and compare these measurements to goals and take action when the process is not on target.
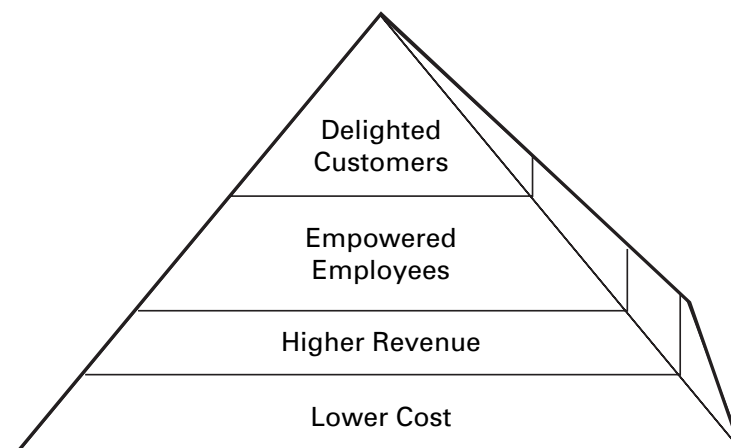
FIGURE 14.3   Results of total quality management. (*Leadership for the Quality Century, 1997, Juran Institute, Inc., Wilton, CT.*)

But the concept of empowered employees goes far beyond self-control. Employees also know how to change the process and to improve performance, improving both the effectiveness and the efficiency of the process.

They also understand how to plan for quality. They understand who their customers are; what the customers need, want, and expect; how to design new goods and services to meet these needs; how to develop the necessary work processes; how to develop and use the necessary quality measurements; and how to continuously improve these processes. The basic principles of empowerment are covered in Section 15.

The Three Fundamental Concepts.
In the past few years many leading companies throughout the world have begun to revisit the fundamental concepts of quality management: customer focus, continuous improvement, and the value of every individual.

Customer Focus.   That customer focus is a fundamental concept of quality management perhaps seems obvious. After all, organizations only exist to provide goods and services to customers. Aren't all organizations customer focused?

For most organizations the answer to this question is a resounding *no.* During the evolutionary progress of almost every industry, the first phase is a focus on quality of the new product in the most basic terms. The goal is to make the product work. The early automobiles, airplanes, and telephones are dramatic examples. There are no customers in the beginning, only wild-eyed inventors trying to make something no one has ever seen before. Later in this section we trace the basic evolution of quality in typical organizations and industries.

The customers provide little input at this stage. Most are not even sure they want these goods or services. They have little understanding of what they are, why they should buy them, or what they do, much less ideas on how to make them better. Unfortunately, many organizations do not progress far beyond this stage. The technology-driven companies and organizations providing health care are two highly visible examples.

One of the hottest trends in business today is the creation of custom products for mass markets. Bicycles, jeans, shoes, carpets, and numerous other items are being customized to individual taste. Financial services, hotel services, meals, and even health care are being designed and delivered to meet individual customer needs (Peppers and Rogers 1993).

The biggest challenge facing companies today is linking measurement of how well they meet customer needs to the actual behavior of the customers. Knowing that you have a 4.3 customer satisfaction rating means nothing. What truly matters is whether a 4.3 satisfaction rating is creating business or losing business.

More and more companies are finding that keeping customers (reducing the churn) is far more profitable than acquiring new ones. A Xerox study found that sales to current customers were over 20 percent more profitable than sales to new customers. The other critical factor is what percent of the customer's business you have. Becoming the dominant supplier can have stunning business results.

Reichheld (1996) documents many of the examples of how companies have gone beyond customer satisfaction and customer retention to customer loyalty. Building customer loyalty is becoming a bedrock of corporate strategic planning and process management.

Continuous Improvement.   Juran (1964) documented the structured approach that many companies use to achieve breakthrough improvements. In recent years rapid change has become a way of life. Many companies now employ this and similar approaches to create improvements by the hundreds and even thousands.

But this was not always the case. For thousands of years societies and governments have been organized to prevent change. In some societies doing something in a different way was punishable by death. In his novel, *The Egyptian,* Waltari (1949) describes how a physician in ancient Egypt was trained to perform 128 different procedures. Only these could be performed, and there was only one way to perform each. Even artists were trained carefully in the only way to draw a bird, a crocodile, or a person.

In medieval Europe the various trade guilds established rigid guidelines for the making of each object. Daring to experiment in the ways things were made or the materials used was grounds for expulsion from the guild. In the Byzantine language the word for change was the same as the word for danger. Change in societies, in production practices, in armies, in governments came slowly. Many societies endured half-witted rulers rather than risk changing the form of government.

Organizations and companies mirrored society. Companies were governed by thick policy manuals and corporate executive instructions in multivolume sets. Promotions were given to those "not rocking the boat." Strong hierarchies were created to control all operations and individual work. Scientific management, the so-called Taylor System was used to carefully define each step in the work process and each person's role. Job descriptions defined clearly what one did and what one did not do.

Things began to change rapidly in the years following World War II. The Japanese were so far behind in many areas of commercial production that they had to improve rapidly to survive. The continuous improvement methods they perfected worked well. Faced with severe competition, many U.S. firms started copying these ideas, some with great success.

The literature now abounds with examples of astonishing improvements. These improvements are being made in manufacturing companies, hospitals, telecommunications companies, government agencies at every level, all types of service companies, and in schools. The names of the means used to achieve these results have become quite familiar to all of us: cross-functional teams, quality control circles, re-engineering, quality action teams, creative idea suggestion systems, process improvement teams, quality in daily work, and many others.

Value of Every Associate.   The value of each associate in an organization is another idea that sounds simple on the surface. For years companies have published clear statements about the strength of their organizations being the people who work for them. But most of these are just hollow statements. The companies are still blindly following the Taylor system. A few planners, managers, or engineers are planning all the steps of every process, defining carefully worded job descriptions, and enforcing the unthinking following of instructions.

Even the most cursory review of history illuminates how radical an idea it is to have each person thinking, creating ideas, challenging authority, and making changes to the system. Entire armies marched side by side with spears pointed forward at exactly the same angle. Archers fired precisely when told. Musketeers marched in ranks, fired precisely timed volleys, reloaded, and fired again. But only on the orders of the commander.

Individuals were trained in long apprentice programs by demanding masters. Rows of clerks transcribed exactly what was written. The early factories contained rows and rows of workers each doing each task exactly the same way.

The average number of implemented ideas per employee per year in the United States is still only 0.16. That is one idea implemented for every six employees per year. In organizations truly valuing the ideas and personal contributions of each employee the number is dramatically higher. Already in the United States, Toyota is achieving eight implemented ideas per employee at its Georgetown manufacturing facilities. Overall, Toyota receives 4,000,000 ideas from its 80,000 employees. Since over 95 percent are implemented, this is over 46 implemented ideas per employee per year (Yasuda 1991).

Some companies in the United States have achieved similar results. Globe Metallurgical and Milliken have averaged over one implemented idea per employee per week. Milliken is now one of the country's leaders at 68 ideas implemented per associate per year. One employee in a Marriott hotel contributed 63 improvement suggestions in one month (Fromm and Schlesinger 1993, p. 8)!

But ideas contributed are just one measure of individual contributions. Other contributions may be even more important. These include participation on quality improvement and quality planning teams, membership on business process re-engineering teams, work on statistical quality control and self-control of their own work processes, and working as members of high-performance or self-directing work teams.

Eastman Chemical was already 6 years into its quality journey in 1985 when they began to recognize the strong connection between culture, values, and quality excellence. Their objective was to identify, understand, and emphasize the people elements of their quality policy. They now use their internally developed quality management process as a vehicle to bring all employees into the

improvement efforts. They use interlocking teams of employees at every level to define how each work process links together with the next and with the customers' needs and expectations.

Eastman Chemical has also formally defined "empowerment" as the creation of a culture "where people have the knowledge, skills, authority, and desire to decide, act, and take responsibility for the results of their actions and for the contribution to the success of the company." They implement this clear, working definition of empowerment by providing just-in-time training where employees come to class with improvement projects already selected. Quality coaches (facilitators) provide direct support back on the job.

The Three Strong Forces.   There are three primary drivers of performance excellence: alignment, linkage, and replication. To achieve breakthrough results the organization must focus its efforts on the most important issues—it must have its strategy correct and the organization's goals, resources, and activities aligned with the strategy. The organization must also understand the cross-functional nature of work, the linkages across the organization. Sometimes called "systems thinking" or "process thinking," this understanding of the way work is done is crucial. Associates in the organization must also be able to replicate successes quickly. A simple improvement may be worth only a few thousand dollars. But replicated 100 times it may become a major contribution to the organization's success.

Alignment.   A recent study by the Association of Management Consulting Firms in the United States found that executives, consultants, and business school professors all agree that business strategy is now the single most important management issue and will remain so for at least the next 5 years (Byrne 1996, p. 46). In the past few years, there has been a new understanding of the importance of strategy. This strategy must include:

1. A clear vision of where the company is going—this must be clearly stated and communicated to every member of the organization in language he or she understands.
2. Clear definitions of the small number of key objectives that must be achieved if the company is to realize its vision.
3. Translation of these key objectives throughout the entire organization so that each person knows how performing his or her job helps the company achieve the objectives. This alignment of all associates with the top priorities of the company is absolutely critical (Sugiura 1992).

One of the biggest changes in the strategic planning process has been the inclusion of many layers of the workforce, customers, suppliers, and even competitors in the planning process. These changes are creating a whole new set of buzzwords: co-evolution, business ecosystems, strategic intent, business designs, core competencies, game theory, and white-space opportunities. The key differences include the creation of networks of new relationships with customers, suppliers, and rivals to gain new competitive advantages, new markets, and new opportunities.

The second big change has been the inclusion of numbers of employees of all ages, levels, and job functions in the planning process. Some years ago, Electronic Data Systems Corporation (EDS) launched a major strategy initiative involving 2500 of its 55,000 employees. A core group of 150 worked full time for a year coordinating the input from the larger group. Finland's Nokia Group recently involved 250 employees in a strategic review. Nokia's head of strategy development, Chris Jackson, reports that the involvement of more people not only makes their ability to implement the strategy more viable, but they also win a high degree of commitment by the process (Byrne 1996, p. 52).

To be effective, strategic quality planning must be used as a tool—a means to an end—and not as the goal itself. It must be an endeavor that involves people throughout the organization. It must capture existing activities, not just add more activities to already overflowing plates. Finally, it must help senior managers face difficult decisions, set priorities, and eliminate many current activities, not just start new ones.

The third change has been the extreme focus, perhaps even obsession, on customers. The new strategic planning starts with customers. Hewlett-Packard brings both customers and suppliers together with general managers from many different business units to work on strategies. For example, they brought together managers from divisions making service-bay diagnostic systems for Ford

with those making workstations for auto plants and those developing electronic components for cars. Many of the ideas for new opportunities came directly from the customers.

Far too many companies have stopped with creating the strategic plan. Their plans are beautifully developed and packaged, but come to nothing. Somehow these companies assume that packaging and distributing the plans to a select number of managers is actually going to make things happen. Nothing could be further from the truth. To really get results these plans must be carefully deployed throughout the entire organization. Every associate must be clearly aligned with the key objectives of the company, every associate must understand the strategic goals and how he or she contributes. Every strategic goal must be broken into subgoals and these must be subdivided into annual goals. The organization must then clearly define the specific work projects which support the annual goals. They must assign clear priorities, establish specific measurements, and provide the resources to achieve the desired results for each project. Strategic deployment is covered in detail in Section 13.

Linkage (Process Management or Systems Thinking).   In the past few years companies throughout the world have embraced the concept of re-engineering with a fervor that defies description. Pioneered in the early 1980s by companies such as IBM, Ford, AT&T, and NCR, and popularized in Michael Hammer's best-selling book, *Reengineering the Corporation,* re-engineering has become a common tool for corporations throughout the world (Hammer and Champy 1993). The definition of re-engineering by Hammer as "the radical redesign of business processes for dramatic improvement" captured and excited the imagination of managers around the world. More recently, Hammer has stated that "the key word in the definition of reengineering is 'process': a complete end-to-end set of activities that together create value for a customer" (Hammer 1996, p. xii).

As companies have rediscovered the importance of linking their activities across all functions and departments in the company, they have also rediscovered how critical it is to think of how many activities are actually in series. Unless we link our efforts across all parts of the company, we fail to achieve the results we so desperately need.

With this critical emphasis on linkage (or process management) the worlds of total quality management and re-engineering converge. A fundamental tenet of quality management since Shewhart in the 1920s (if not before) has been the importance of controlling the process. Deming later further developed Shewhart's ideas of statistical process control with the now famous PDCA cycle (Plan, Do, Check, Act), and Juran pioneered the concepts of process improvement with his text *Managerial Breakthrough* (Juran 1964). As leading companies moved into rapid improvement activities in the 1980s, the need for process management became clear. In the manufacturing plants the series nature of work was obvious. If any part of an assembly line failed or created a bottleneck, the whole line suffered. What wasn't so obvious was how many administrative processes were also series systems. With a mistake in the order entry step, there may be no way to complete the delivery of the product or service on time and correctly.

The steps to managing the critical linkages and making dramatic and continuous improvements to the key processes are now well defined. The first step is identifying the organization's key processes. There are numerous methods for doing this, but the essence of them all is narrowing down the list to the most important few and making sure everyone knows them. The next step is creating the necessary measurements. Many companies have long lists of measurements for almost every task in the organization. Most of these measurements are focused on departmental activities and many are related to the budget. But these same companies have few measurements on the critical processes that drive the success of the company. They cannot tell you how long it takes from the receipt of an order from a customer to the time the customer receives the goods or services, much less the time until they receive payment. They do not know the real cost of processing the order, delivering the product, or providing follow-up service.

The final step in managing the critical linkages is to actually get serious about managing these linkages. Without major changes in the structure of the organization, without assigned process owners, without realignment of authorities, responsibilities, and accountabilities, nothing much happens.

Although quality management has for many years been about process control, improvement, and planning, we have still not developed all of the needed understanding, tools, and measurements to manage in this critical new way. This is a major challenge for the future.

The single most important word in the definition of process is "customer." As many of us have discovered in the past decade, a company is a collection of processes, and the customer only sees the company in terms of the output of those processes. The customer does not care how the company is organized, who reports to whom, what the various titles are, or even where the different departments are located. The customer does not even care what parts of the goods or services are produced by the company, the company's suppliers, or the company's competitors. The customers request products, want them delivered exactly when promised, want the required service to be available when needed, and want the bills to be exactly as agreed upon.

If a process is not providing value to the customer, the process is producing waste. There are many subprocesses in a company that exist primarily as enablers for the company to produce value to the customer. Most key processes touch the customer directly, and these processes must add value for the customer.

The second key to managing processes is to determine exactly what value is added by each step in the process. When we see a purchase order for a $30 book with six signatures that has taken 6 weeks to process, we know there is a better way. What value has this process added? Organizations throughout the world have been stunned to learn how many steps they have in key processes, how many useless handoffs, and how much wasted time and effort.

Just focusing on cycle-time reductions can illuminate how unmanaged many of our key processes are. The Royal Leicester Infirmary in the U.K. reduced a neurological testing procedure from 40 days to 1 day and removed 40 percent of the administrative costs by redesigning the process in which 14 departments worked together. Motorola reduced from 6 weeks to under 100 minutes the process time required to take a pager order, produce the pager, and ship it.

The third critical area of managing the critical linkages is the realization that almost all key processes cut across many different areas of the company. To manage these processes successfully requires a team-based approach involving employees with new skills, new understanding of the company's strategy, goals, and competitors, and new tools for doing their rapidly expanding jobs.

The challenge for the future is to continue to identify these skills, tools, and understandings, and to know which are part of the essential core knowledge of the company (which must be taught to all employees) and which are the needed new skills and tools. Companies that a few years ago thought they could rush through a "quality training program" and be through with it are now finding that training has become a full-time activity.

Many of the ideas of process management, teamwork, and problem-solving skills are now finding their way into business and engineering schools, but companies need to quickly introduce all employees to the key processes, the measurements used, and the way the company continuously challenges and changes process performance. The topic of process management is covered in Section 6.

Replication. Probably the most powerful and the least understood way to dramatically accelerate the results of quality and productivity improvement efforts is the third strong force, replication. An example from a leading international service company makes this clear. The CEO was justifiably proud of some of their accomplishments. In one location a true chronic problem had been solved—the savings were over $350,000/year. In another location, a different chronic problem had been reduced by 75 percent. The increased revenues were also in the hundreds of thousands of dollars.

It was not hard for the CEO to do the math. If each of the more than 250 locations could duplicate these results, the company would exceed its aggressive financial goals for the next year. But he knew how hard it would be to get each of the locations to understand what had been done in these two locations, to modify the approach to fit their situations, and to apply a similar problem-solving methodology and achieve similar results.

When we address replication we are learning first hand about resistance to change, the dreaded not-invented-here syndrome, the entrenched beliefs that every location is different, and even the reluctance of many corporations to "stifle innovation and creativity" by directing business units and branches to act. Problems remain unsolved, new solutions are invented and tried, opportunities are missed, and companies muddle along with slow rates of change and disappointments in results. The successful companies take action; they make things happen. They

use passive means to encourage replication, they use active means to force replication, and they make replication an obligation not an option.

Passive systems include sharing, reward and recognition, newspaper articles, and team presentations. The results of quality improvement projects are made known widely throughout the organization. In these systems we assume that those with similar problems or opportunities will hear about the project, obtain the information they need, and act.
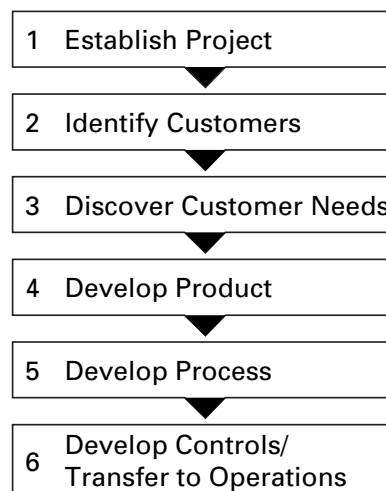
Active sharing systems force the issue. At Honda's annual facilitator network meetings (attended by over 3000 people worldwide), participants are expected to share one completed and well-documented project and to study thoroughly four others that could be used in their location. Upon returning to their location, they are expected to implement these four projects. The support structure is in place to assist them, and results are expected.

The Three Critical Processes for Quality Management.   These three management processes are not new. They are the same management processes we have used for years to manage finance. This commonality is helpful to managers. Their long experience in managing for finance becomes useful to them when they enter the world of managing for quality. These three processes are closely interconnected.

Quality Planning.   The logical place to start is quality planning. Quality planning consists of a universal sequence of events—a quality planning roadmap. We first identify the customers and their needs. We then design products (goods and services) which respond to those needs. We also design processes which can produce these goods and services. Finally, we turn the plan over to the operating forces. They then have the responsibility of conducting operations. They run the process, produce the goods and services, and satisfy the customers. The quality planning process is summarized in Figure 14.4.

The quality planning process is discussed in Section 3. In later sections we provide some in-depth coverage of some of the more technical tools used in quality planning (or as some call it, quality by design). These tools include experimental design (Section 47) and reliability prediction and reliability estimation (Section 48).

But no matter how well we apply our methods and tools of quality planning, most processes are not perfect. They have associated with them some chronic waste: time delays, errors, rework, non-value-added work, scrap. This waste is built into the plan; it goes on and on. We first have to provide the control systems necessary to maintain quality at the planned levels. And next we must search for opportunities to make dramatic improvements in the levels of quality achieved. Figure 14.5 makes these relationships clear.

1	Establish Project
2	Identify Customers
3	Discover Customer Needs
4	Develop Product
5	Develop Process
6	Develop Controls/ Transfer to Operations

FIGURE 14.4   The quality planning process. (*Leadership for the Quality Century, 1997, Juran Institute, Inc., Wilton, CT.*)
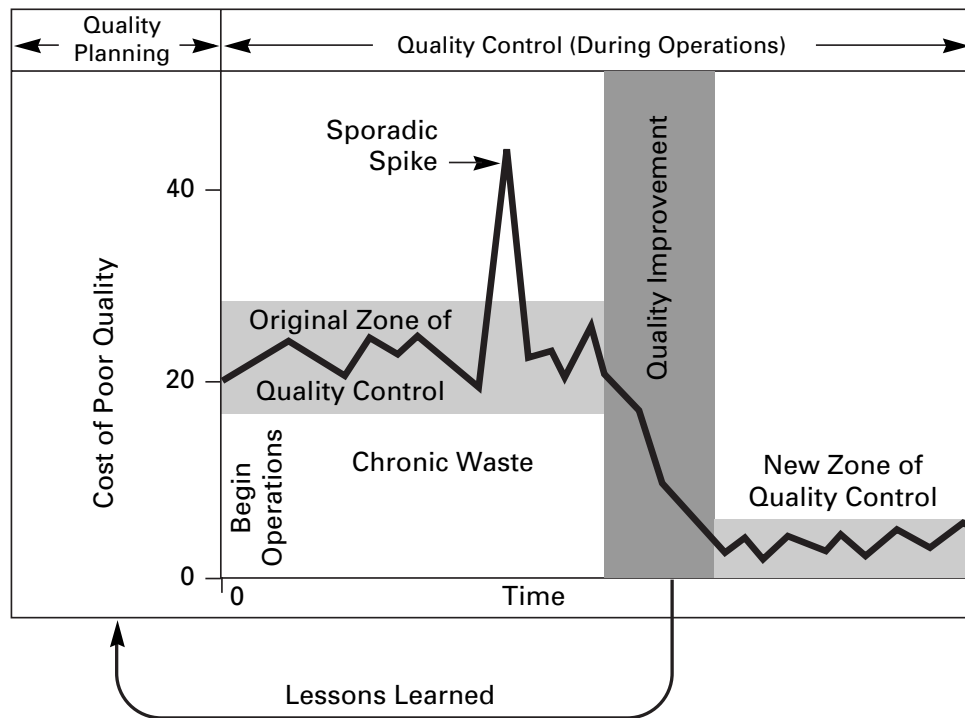
FIGURE 14.5   The Juran trilogy. (*Juran Institute, Inc., Wilton, CT.*)

In this figure we have plotted the cost of poor quality on the vertical scale, so what goes up is bad. These are the costs associated with imperfection. Despite our best efforts at planning, the costs in this example are about 20 percent. These costs could be from defects or they could be even harder to see. Examples of hard-to-detect costs are work-in-process inventory, non-value-added work, underutilized capacity, and unnecessary delays and hand-offs.

Our first job is to build the quality control system to ensure that our quality performance is at least as good as planned. On the diagram in Figure 14.5 we see a sporadic spike, a major deviation from our planned level of performance. In this example, the quality control system seems to be working well. Since this point is a spike, it indicates that the problem was detected quickly, the cause of the problem found quickly, and the cause was removed quickly. Little time elapsed before the quality performance was back at the planned levels.

In many real-life cases our quality control systems do not function this well. Several days or even weeks may go by before we realize we have a problem. Then we may spend more days or weeks investigating the possible causes of the problem and more days or weeks developing remedies. The new level of costs of poor quality persists during this time, causing much damage to the organization.

Quality Control.   What the operating forces can do is minimize this waste. They do this through quality control. Quality control relies on five basics: a clear definition of quality; a target, a clear goal; a sensor, a way to measure actual performance; a way to interpret the measurement and compare with the target; and a way to take action, to adjust the process if necessary. Quality control is discussed in Section 4. Statistical process control is covered thoroughly in Section 45.

Quality Improvement.   But all of this activity only keeps quality at the planned level. We must take deliberate, specific actions if we wish to change this level. As Deming pointed out some time ago, "Putting out the fires in a hotel doesn't make the hotel any better." As he states in *Out of the Crisis* (Deming 1982, p. 51), "Putting out fires is not improvement of the process. Neither is discovery and removal of a special cause detected by a point out of control" (our sporadic spike in Figure 14.5). "This only puts the process back to where it should have been in the first place (an insight of Dr. Joseph M. Juran, years ago)."

Juran (1964) describes the quality improvement process used by individuals and organizations to make "breakthrough" changes in levels of performance. The quality improvement process is directed at long-standing performance levels. The quality improvement process questions whether this is the best that can be attained. Juran describes the quality improvement process in Section 5.

The Total Quality Management Infrastructure.   Figure 14.6 shows the main elements of the total quality infrastructure. These elements include the quality system, customer-supplier partnerships, total organization involvement, measurement and information, and education and training.

The Quality System.   The total quality infrastructure consists of several key pieces. The first, and one of the most important, is the quality system. Best defined by ISO Standard 9004-1, the quality system is a critical building block for total quality management. The ISO Quality System standards are described in detail in Section 11.

A good quality system also contains customer supplier partnerships. Again the ISO 9000 series of standards provides a good starting point for contractual relationships by adding a solid quality management structure. But many companies are going far beyond contractual relationships. Many customer-supplier relationships in the leading U.S. companies are evolving quickly to resemble those pioneered by Toyota and other leading Japanese automotive companies.

To achieve quality improvement at a revolutionary pace, we must also have total organization involvement. In the words of of an interdisciplinary study group convened at Columbia University in 1988 to study global competitiveness (Starr 1988):

> …we have collected some basic principles of what makes a firm competitive, the first of which is quality.
> The successful business no longer sees employees as a cost of production but as a resource for production. Although job uncertainty will never be eliminated, it must be recognized that long-term commitment of and to workers is at least as important as machinery or technology. Employee involvement in efforts to improve productivity and quality is vital, and they must also be able to share in the gains.

A key element of the infrastructure is measurement and information. Donald Peterson, former chairman of the Ford Motor Company, stresses how important having the right information is. When Ford benchmarked Mazda they were quite impressed with how well Mazda manages this part of the business. Peterson (1992) states,
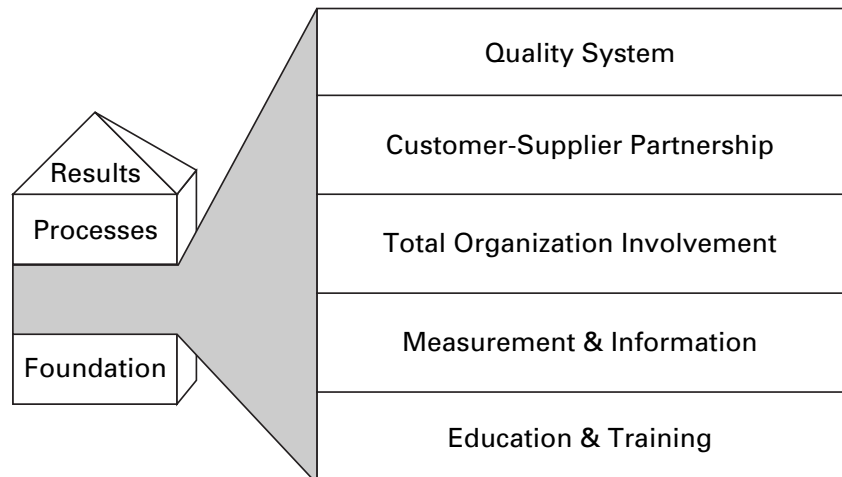
FIGURE 14.6   The total quality infrastructure. (*Leadership for the Quality Century, 1997, Juran Institute, Inc., Wilton, CT.*)

> Perhaps, most important, Mazda had been able to identify the types of information and records that were truly useful. It didn't bother with any other data. (At Ford) we were burdened with mountains of useless data and stifled by far too many levels of control over them.

The last, and perhaps most important, part of the infrastructure is education and training. Organizations must train the teams in how to work as teams and in how to diagnose problems and provide remedies. This type of training should be directed at changing behavior. The training should be just in time. The best learning comes by doing. Training in how to improve quality should be done during actual improvement projects. The training should be designed to help the teams complete these projects quickly and successfully. Training is covered in Section 16.

THE EVOLUTION OF TOTAL QUALITY

In many countries, industries, and companies TQM has appeared to evolve through several distinct steps or phases. These phases include a focus on product quality, on product process quality, service quality, service process quality, business planning, strategic quality planning, and integrated strategic quality planning.
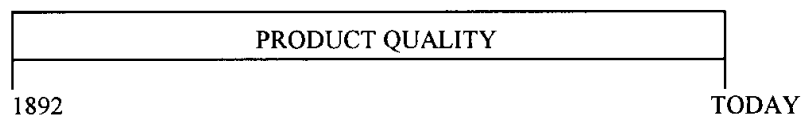
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Product Quality.   All organizations began their quality management efforts with a focus on product quality. At the first introduction of a product, this is necessarily a definition of product quality from the producer's point of view. Since the product is unknown to the customers, the customers have little input as to the definition of quality. They may be surveyed for needs and wants, but in the case of a truly new product their inputs are ambiguous and somewhat vague.

In a recent study of the evolution of quality in telecommunications, this was clearly the case (Endres and Godfrey 1994). The telephone was truly a new product. Potential customers were amazed it worked at all and had absolutely no idea how it worked. The driving forces for defining quality were the engineers trying to make it work well enough to be a salable product. As early as 1892, the Bell System was developing inspection procedures to ensure that the specifications and requirements developed by the engineers (the company's definitions of quality) were being met by the production personnel.

This was also the case in other industries such as health care. For many years in modern medicine the definitions of quality focused on outcomes. These were defined by the medical specialists, the doctors. Elaborate quality assurance procedures, usually based on inspection, were developed to review the outcomes and assign responsibility for less-than-perfect outcomes. In Section 29 on automotive quality, a similar evolution is traced.

For other industries (service or manufacturing), this also appears to be the case. The early airlines concentrated their entire efforts on product quality—providing quick transportation from point A to point B. This basic definition of product quality—safe, fast, reasonably on-time air travel—occupied all of their efforts for years.

We should also note that this focus on product quality has continued up to the present. Telecommunications companies extended their efforts beyond initial quality to reliability in the field, then to availability, usability, maintainability, and other definitions of product quality. Some of the methods used to manage these broadened definitions of product quality have become quite sophisticated.

In health care, much recent work on clinical outcomes would fall in this category. Researchers have extended the traditional definitions of outcome to include patient performance, lack of pain, and

ability to work. This carries the traditional definition of outcome quality far beyond the walls of the hospital (Godfrey 1997).

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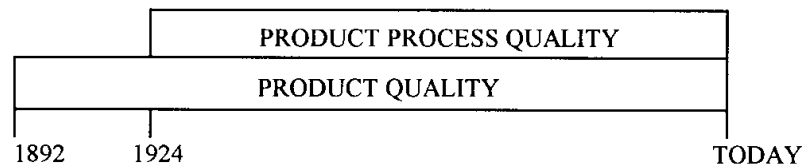
Product Process Quality.   The next phase of the evolution for telecommunications quality began in 1924 with the creation of the control chart. For some time it had been becoming evident that controlling product quality by final inspection was quite expensive. In the installation forces of the rapidly growing American Telephone & Telegraph company, the rallying cry had become, "Do it right the first time." Finding the wiring errors in complex switching machines after the machine had been assembled was a time-consuming, costly process. It was far more economical to ensure functioning parts and carefully control the assembly than to go back and try to find the problems.

Earlier examples abound. During World War I, there is evidence that the British developed rather sophisticated control procedures for ensuring proper tensioning of the wires between the wings of the biplane fighters.

But it was the creation of the control chart that made it clear how easily process control could be transferred to the operating forces. This would reduce the reliance on final inspection and free up numerous people for productive work. In this way product quality could be improved and costs driven down at the same time.

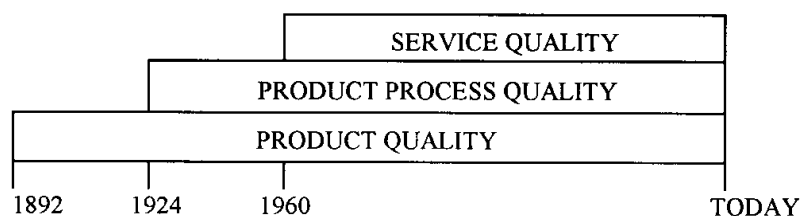This stage of product process quality—focus on the processes producing the products—has also continued to the present. Many sophisticated methods have been added to the arsenal: engineering process control, experimental design, evolutionary operations, robust design, and more recently process simplification and reengineering.

In health care there are numerous examples: patient-focused care, care maps, clinical guidelines, protocols. Any methods that try to improve the outcomes of our work through improving the processes by which we create those outcomes are in the product process phase. For the most part, in other industries, these have focused on the cost side of producing the product.

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Service Quality.   The next phase for some industries began in the early 1960s. We suspect for other industries it had begun much earlier, for others not until the 1980s or even 1990s. This was the expansion of the traditional definition of product quality to include the services surrounding the product. For telecommunications this expansion includes repair and maintenance services, order entry, billing, and modular phones that the customer could easily self-install and maintain. In health care many new ideas emerged. These included patient-focused care and many other means of providing services beyond basic clinical ones. Many new ideas emerged concerning admissions, waiting times, bedside manner, housekeeping, laundry, room layouts and decor, phones, TVs, food (beyond basic nutrition), parking, and other services surrounding the basic product of the correct outcome. These are sometimes called the features, or the salability part of quality.

For many manufacturing companies the 1960s and 1970s were the wake-up calls for this aspect of quality. The customer was no longer just interested in the quality of the car. Service provided by

the dealers, availability of parts, roadside assistance, the sales experience, financing, leasing, and many other aspects of the supplier/customer relationship became part of the competitive quality battleground. In the late 1980s we saw this accelerated with the introduction of the Japanese luxury cars (Acura, Infiniti, and Lexus) with their special dealerships, new service relationships, and new levels of support. General Motors has applied these concepts to the basic car in its Saturn Division.

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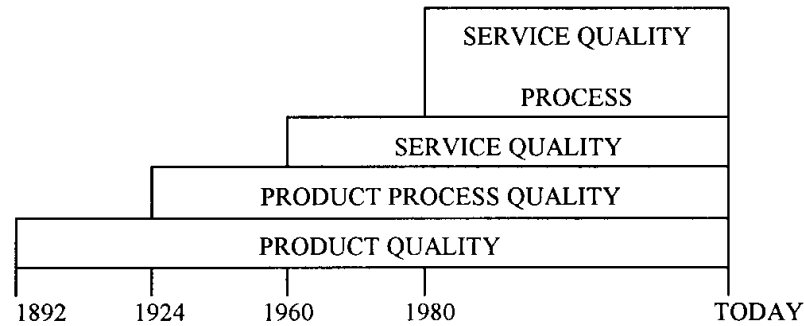
Service Quality Process.   In the 1980s a new focus on quality occurred. Pioneered by IBM, companies started focusing on the costs of providing the quality of these services—or business process quality management or improvement. Many of the same techniques (for the most part rather standard industrial engineering tools) used in product process quality were app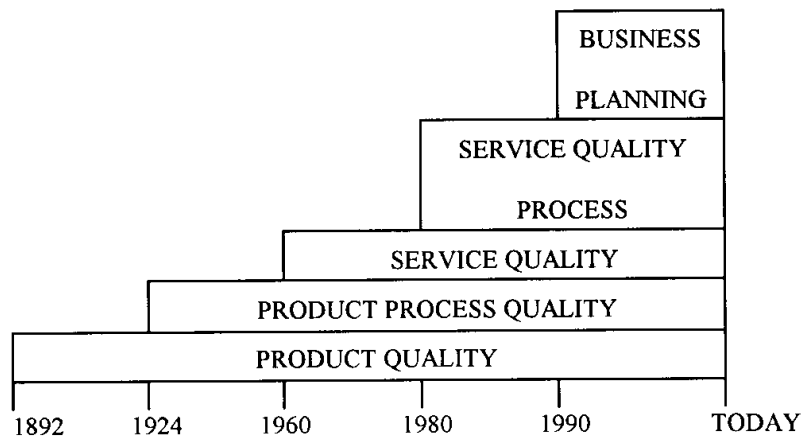lied for the first time to the horizontal processes that cut across organizations and had been, for the most part, totally unmanaged.

Some new ideas also emerged. The concept of a process owner and a process team expanded the power of a quality council by continuously examining and identifying opportunities for team interventions in critical business processes. In many ways these process teams acted as focused councils, deploying improvement, control, and planning teams to the macro process or to micro processes within the macro process.

Again the focus was primarily on costs. These re-engineering or business process quality efforts were directed at reducing cycle times, reducing numbers of steps or handoffs, and improving efficiency overall. Many of these business process interventions also improved the quality of the output.

We began to see a cycle emerging. The evolutionary process of total quality management seems to alternate between a focus on quality and a focus on the costs to attain that quality.

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Business Planning.   In the past few years we have observed many companies starting to integrate quality management into their business planning cycles. This integration of the quality goals with the financial goals has been a major thrust of the leading companies. Recently this integration was listed as the major effort currently underway by the respondents to the Business Roundtable survey on TQM.

The setting of quality goals; the subdividing of goals into subgoals, annual goals, and projects; and the deployment throughout the organization (hoshin kanri, hoshin planning, policy deployment, or strategic quality planning) has become one of the major breakthroughs in total quality management for many companies. Some are actually going beyond the annual business planning cycle to incorporate these methods in their 5-year or even longer-term plans.

This naturally leads to the question: What are the next steps in the evolution of total quality? The immediate next step to the pyramid is fairly obvious—strategic quality planning. Some companies are beginning to go even further: they have implemented integrated strategic planning where they are involving customers and suppliers in joint strategic planning. The details of strategic quality planning and those of strategic deployment are given in Section 13.

THE IMPACT OF NATIONAL AND INTERNATIONAL QUALITY AWARDS ON TOTAL QUALITY MANAGEMENT

One of the most useful trends in the past decade has been the self-assessment activities of many companies throughout the world. Companies worldwide are using the criteria of the Malcolm Baldrige National Quality Award, the European Quality Award, the Deming Application Prize, and many other national quality awards to assess their current performance against a reasonable set of guidelines for total quality.

These assessments can provide senior managers with a clear baseline of current quality performance levels. When these managers are willing to take the time to understand the criteria, understand what their own assessment scores mean, and to understand what is necessary to improve these scores, they can develop meaningful and realistic action plans for improving their organizations.

A very important step in this process is to first understand one's own organization's performance level and compare it to the performance level of another organization.

One of the most striking benefits of these national and international quality awards has been the stunning increase in senior management contact with true leaders in total quality. For the first time in the history of the United States, senior managers are hearing what other companies have achieved in quality, how they obtained these results, and what the executive leadership's role in these achievements was.

This benchmarking is, both on a personal level and an organizational level, one of the most important trends in modern quality management. When asked by *Boardroom Reports* if there was a single most important thing a company could do to change the company culture and achieve remarkable results, the then-chairman of Ford Motor Company, Donald Peterson, answered: "There sure is. Each company must find out which other companies in the world are best in that industry. Then, each company must benchmark operations against the most efficient—and most profitable—foreign and domestic businesses.…those that do—such as Xerox—have had incredible results."

Peterson went on to explain that at Ford, "we began by comparing our manufacturing processes, design, marketing, financial management and quality, with the best of the Japanese operations."

Peterson stated:

> Comparisons should be based on speed, capital investment, wasted effort, number of employees, and any other yardstick with which the company can measure both its own and other operations.
>
> The next step is to get managers in the key departments to acknowledge that another business is doing all or part of their job better. That becomes easier when the CEO says that he looks on the benchmarking as an opportunity, not as criticism. Good managers are energized by that challenge.
>
> Next, send groups of managers to visit the companies with the superior operations.

Ford included union representatives on the visiting teams. Later they assembled teams of key people in the affected departments to discuss the ideas they had seen. They then decided which ideas they could implement and how. Benchmarking is covered in Section 12.

The Creation of the Malcolm Baldrige National Quality Award.   During the 1980s there was a growing interest in the United States in promoting what is now called total quality. Many leaders in the United States felt that a national quality award, similar to the Deming Application Prize of the Union of Japanese Scientists and Engineers, would help stimulate the quality efforts of U.S. companies.

A number of individuals and organizations proposed such an award, leading to a series of hearings before the House of Representatives Subcommittee on Science, Research, and Technology. Finally, on January 6, 1987, the Malcolm Baldrige National Quality Improvement Act of 1987 was passed. The act was signed by President Ronald Reagan on August 20, 1987 and became Public Law 100-107. This act provided for the establishment of the Malcolm Baldrige National Quality Award Program. The purpose of this award program was to help improve quality and productivity by (House Resolution 812, U.S. Congress):

(A) helping stimulate American companies to improve quality and productivity for the pride of recognition while obtaining a competitive edge through increased profits;

(B) recognizing the achievements of those companies which improve the quality of their goods and services and provide an example to others;

(C) establishing guidelines and criteria that can be used by business, industrial, governmental and other organizations in evaluating their own quality improvement efforts; and

(D) providing specific guidance for other American organizations that wish to learn how to manage for high quality by making available detailed information on how winning organizations were able to change their cultures and achieve eminence.

The act provided that up to two awards could be presented to companies in each of three categories:

- Small businesses
- Companies or their subsidiaries
- Companies which primarily provide services

The act also stated that companies must apply for the award by submitting an application, in writing, for the award. And the company must permit a "rigorous evaluation of the way in which the business and other operations have contributed to improvements in the quality of goods and services."

In 1998 pilot examinations of health care and educational organizations were conducted. Recently the Malcolm Baldrige National Quality Award was expanded to include educational and health care organizations.

The act also called on the Director of the National Bureau of Standards (now the National Institute of Standards and Technology) to

rely upon an intensive evaluation by a competent board of examiners which shall review the evidence submitted by the organization and, through a site visit, verify the accuracy of the quality improvements claimed. The examination should encompass all aspects of the organization's current quality management in its future goals. The award shall be given only to organizations which have made outstanding improvements in the quality of their goods or services (or both) and which demonstrate effective quality management through the training and involvement of all levels of personnel in quality improvement.

In addition to the establishment of the Board of Examiners, the act also called for the establishment of a Board of Overseers consisting of at least five individuals who have demonstrated preeminence in the field of quality management.

The Malcolm Baldrige National Quality Award Development Strategy.   In creating the Malcolm Baldrige National Quality Award, the first step was to develop the criteria which would be used to evaluate the organizations applying. The Director of the National Bureau of

Standards selected Dr. Curt Reimann as Director of the Malcolm Baldrige National Quality Award. Dr. Reimann immediately began calling on individuals and organizations throughout the United States and the world for their suggestions and contributions to creating the criteria and the process by which these criteria would be evaluated. Dr. Reimann and his staff collected much information on other awards, such as the JUSE Deming Prize and the NASA quality award, as background information. They then selected a small team of volunteers to help create the first draft of the criteria. These draft criteria were then reviewed in intensive focus group sessions by selected experts from organizations throughout the United States (Reimann 1992*b*).

One of the most important actions taken by the director, his team, and the volunteers at this stage was to create a clear design strategy for the award program. The elements of the strategy were:

- To create a national value system for quality
- To provide a basis for diagnosis and information transfer
- To create a vehicle for cooperation across organizations
- To provide for a dynamic award system which would evolve through consensus and be continuously improved

The design strategy has been followed carefully. The award criteria have been changed and improved each year. This section does not try to capture the evolution of the criteria but rather describes the current, 1998 criteria. These criteria are presented in detail in a booklet available free from the National Institute of Standards and Technology (U.S. Department of Commerce 1998).

The Malcolm Baldrige National Quality Award Criteria are the basis for making awards and giving feedback to the applicants. The criteria also have three other important purposes:

- To help raise quality performance standards and expectations
- To facilitate communication and sharing among and within organizations of all types, based upon a common understanding of key quality and operational performance requirements
- To serve as a working tool for planning, training, assessment, and other uses

The Malcolm Baldrige National Quality Award Core Values.

There are 11 core values and concepts embodied in the award criteria. These core values and concepts are as follows:

Customer-Driven Quality. Emphasis here is placed on product and service attributes that contribute value to the customer and lead to customer satisfaction and preference. The concept goes beyond just meeting basic customer requirements, including those that enhance the product and service attributes and differentiate them from competing offerings. Customer-driven quality is thus described as a strategic concept directed towards customer retention and market share gain.

This focus on the customer has even been emphasized by the President of the United States (George Bush, *1993 Award Criteria,* National Institute of Standards and Technology, Malcolm Baldrige National Quality Award):

> In business, there is only one definition of quality—the customer's definition. With the fierce competition of the international market, quality means survival.

The emphasis on quality management and the customer has crossed administrations and political parties in the United States, as shown by this statement from the President (William J. Clinton, *1998 Award Criteria,* National Institute of Standards and Technology, Malcolm Baldrige National Quality Award):

> Quality is one of the keys to the continued competitive success of U.S. businesses. The Malcolm Baldrige National Quality Award, which highlights customer satisfaction, workforce empowerment, and increased productivity, has come to symbolize America's commitment to excellence.

Leadership.   A key part of the MBNQA focus is on senior executive leadership. The leaders must create a customer orientation, clear and visible quality values, and high expectations. This concept stresses the personal involvement required of leaders. This involvement extends to areas of public responsibility and corporate citizenship as well as to areas of development of the entire work force. This concept also emphasizes such activities as planning, communications, review of company quality performance, recognition, and serving as a role model.

Continuous Improvement and Learning.   This concept includes both incremental and "breakthrough" improvement activities in every operation, function, and work process in the company. It stresses that improvements may be made through enhancing value to customers; reducing errors, defects, and waste; improving responsiveness and cycle-time performance; improving productivity and effectiveness in the use of all resources; and improving the company's performance and leadership position in fulfilling its public responsibilities and corporate citizenship.

The addition of learning to the core values in recent editions of the criteria refers to the adaptation to change leading to new goals and/or approaches. Learning and improvement need to be embedded in the way the organization operates.

Valuing Employees.   This concept stresses the fact that a company's success depends increasingly on the knowledge, skills, and motivation of its work force. Employee success depends increasingly on having opportunities to learn and to practice new skills. Companies need to invest in the development of the work force through education, training, and opportunities for continued growth. There is an increasing awareness in the United States that overall organization performance depends more and more on work force quality and involvement. Factors that bear upon the safety, health, well-being, and morale of employees need to be part of the company's continuous improvement objectives.

Fast Response.   The value of shortening time cycles is also emphasized. Faster and more flexible response to customers is becoming each year a more critical requirement of business management. Improvements in these areas often require redesigning work processes, eliminating unnecessary work steps, and making better use of technology. Measures of time performance should be among the quality indicators used by leading organizations. Objectives regarding response time, quality, and productivity should be integrated.

Design Quality and Prevention.   Throughout the criteria the importance of prevention-based quality systems are highlighted. Design quality is a primary driver of "downstream" quality. This concept includes fault-tolerant (robust) products and processes. It also includes concept-to-customer times, the entire time for the design, development, production, and delivery to customer of new goods and services.

The concept of continuous improvement and corrective action involving "upstream" interventions is also covered here. This concept stresses that changes should be made as far upstream as possible for the greatest savings. This value also recognizes that major success factors in competition include the design-to-introduction cycle times. To meet the demands on rapidly changing national and international markets, companies need to carry out "concurrent engineering" of activities from basic research to commercialization.

Long-Range Outlook.   This concept stresses the need to take a long-range view of the organization's future and consider all stakeholders: customers, employees, stockholders, and the community. Planning must take into account new technologies, the changing needs of customers, and the changing customer mix, new regulatory requirements, community/societal expectations, and competitors' strategies. Emphasis is also placed on long-term development of employees and suppliers, and on fulfilling public responsibilities and serving as a corporate citizenship role model.

Management by Fact.   This concept stresses the need to make decisions based on reliable data, information, and analyses. These data need to accurately reflect the needs, wants, expectations, and perceptions of the customers; to give accurate descriptions of the performance of goods and services

sold; to reflect clearly the market situation; to portray accurately the offerings, performance levels, and satisfaction levels of competitors' goods and services; to provide clear findings of employee-rated issues; and to accurately portray the cost and financial matters. The role of analysis is stressed. Here, also, emphasis is placed on the role of benchmarking in comparing organizational quality performance with the performance of competitors or best-in-class organizations.

The need for organization-wide performance indicators is also stressed. These indicators are measurable characteristics of goods, services, processes, and company operations. They are used to evaluate, track, and improve performance. They should be clearly linked to show the relationships between strategic goals and all activities of the company.

Partnership Development.   The need to develop both internal and external partnerships to accomplish overall goals is also emphasized in the MBNQA core values. These partnerships may include labor-management relationships; relationships with key suppliers; working agreements with technical colleges, community colleges, and universities; and strategic alliances with other organizations.

Corporate Responsibility and Citizenship.   The core values and concepts also emphasize that the organization's quality system should address corporate responsibility and citizenship. This includes business ethics, protection of public health, public safety, and the environment. The company's day-to-day operations and the entire life cycle of the products sold should be considered as they impact health, safety, and environment. Quality planning should anticipate any adverse impacts from facilities management, production, distribution, transportation, use, and disposal of products.

Corporate responsibility also refers to leadership and support of such areas as education, resource conservation, community services, improving industry and business practices, and sharing of non-proprietary quality-related information, tools, and concepts.

Results Focus.   The Award criteria stress results throughout. They emphasize that performance measurements need to focus on key results. But these results should not be just financial. Results should be guided and balanced by the interests of all stakeholders—customers, employees, stockholders, suppliers and partners, the public, and the community. Company strategy should explicitly include all stakeholder requirements. The use of a balanced composite of performance measurements offers an effective means to communicate short- and longer-term priorities, to monitor actual performance, and to marshal support for improving results.

The Malcolm Baldrige National Quality Award Criteria.   The core values and concepts described previously are embodied in seven categories:

1.0   Leadership
2.0   Strategic Planning
3.0   Customer and Market Focus
4.0   Information and Analysis
5.0   Human Resource Focus
6.0   Process Management
7.0   Business Results

The dynamic relationships among these seven categories are best described by Figure 14.7, as presented in the 1998 Award Criteria booklet.

Leadership, Strategic Planning, and Customer and Market Focus represent the leadership triad. These categories are placed together to emphasize the importance of a leadership focus on strategy and customers. Human Resource Focus, Process Management, and Business Results represent the results triad. A company's employees and its supplier partners through its key processes accomplish the work of the organization that yields the business results. All company actions point towards business results— a composite of customer, financial, and nonfinancial performance results, including
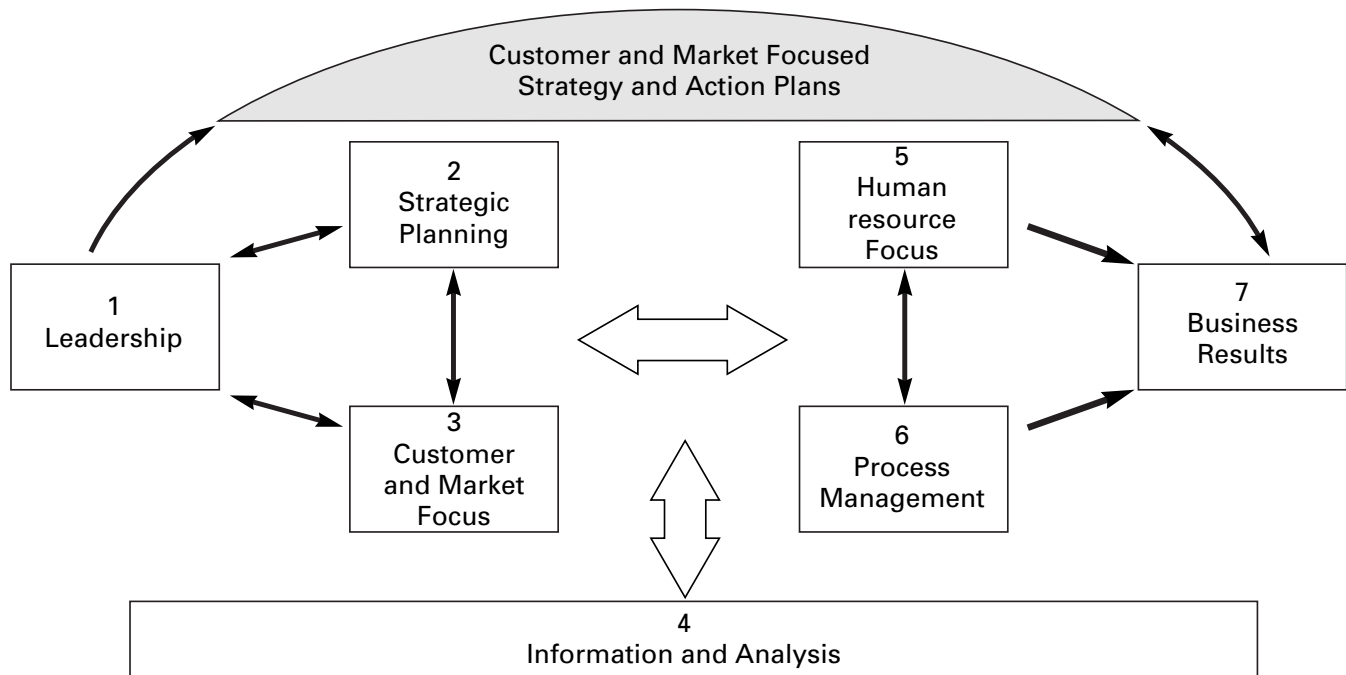
FIGURE 14.7 The Malcolm Baldrige Criteria for Performance Excellence Framework—a systems perspective. (*National Institute of Standards and Technology, 1998, p. 43.*)

human resource results and public responsibility. Information and Analysis is critical to effective management and to a fact-based system for improving company performance and competitiveness. Information and Analysis serve as the foundation for the performance management system.

The seven categories are further subdivided into 20 examination items, each focusing on a major requirement. Each item contains one or more areas to address. There are 29 areas to address. The seven categories, the 20 examination items, and the points for each category and examination item are shown in Table 14.1.

The areas to address give specific instructions as to what information should be contained in the application form. Notes supporting each section give further explanation and clarification. The notes also help the applicant understand where certain data should be reported when there seem to be several possibilities.

An example of an examination item and its four areas to address is provided as Figure 14.8.

The Emphasis on Results in the Malcolm Baldrige National Quality Award.

During the first years of the Malcolm Baldrige National Quality Award, some people felt that too much emphasis was placed on quality systems and too little emphasis was placed on quality results. Conti (1992) compared the strengths and weaknesses of the Deming Application Prize, the European Quality Award, and the Malcolm Baldrige National Quality Award in an incisive paper. Conti's criticisms of systems-based assessments are right on the mark. The proof of the effectiveness of any quality system *must* be in the results produced by the system.

Conti points out the MBNQA's apparent overfocus on systems and underfocus on actual results. In actual fact, the applicants for the Malcolm Baldrige National Quality Award have always emphasized results, sometimes even entering charts and data in inappropriate places in the application form. The examiners also looked for results in almost every area addressed.

However, the language in the application form was not clear in the early years, and it was possible to interpret the application process as only giving 10 percent weight to customer satisfaction results and 10 percent weight to internal results. Some companies, and many reviewers, read the guidelines this way.

The 1998 revision makes it absolutely clear that the focus is on results. Criteria 7, Business Results, is now worth 450 points out of 1000.

TABLE 14.1 Malcolm Baldrige National Quality Award: 1998 Criteria for Performance Excellence. U.S. Department of Commerce, National Institute of Standards and Technology, National Quality Program, Gaithersburg, MD.

1995 Examination Items and Point Values
1.0 Leadership (110 points)
1.1 Leadership System (80)
1.2 Company Responsibility and Citizenship (30)
2.0 Strategic Planning (80 points)
2.1 Strategy Deployment Process (40)
2.2 Company Strategy (40)
3.0 Customer and Market Focus (80 points)
3.1 Customer and Market Knowledge (40)
3.2 Customer Satisfaction and Relationship Enhancement (40)
4.0 Information and Analysis (80 points)
4.1 Selection and Use of Information and Data (25)
4.2 Selection and Use of Comparative Information and Data (15)
4.3 Analysis and Review of Company Performance (40)
5.0 Human Resource Focus (100 points)
5.1 Work Systems (40)
5.2 Employee Education (30)
5.3 Employee Well-Being and Satisfaction (30)
6.0 Process Management (100 points)
6.1 Management of Product and Service Processes (60)
6.2 Management of Support Processes (20)
6.3 Management of Supplier and Partnering Processes (20)
7.0 Business Results (450 points)
7.1 Customer Satisfaction Results (125)
7.2 Financial and Market Results (125)
7.3 Human Resource Results (50)
7.4 Supplier and Partner Results (25)
7.5 Company-Specific Results (125)
Total Points 1000

Source: National Institute of Standards and Technology, 1998 Criteria for Performance Excellence, *Malcolm Baldrige National Quality Award,* Gaithersburg, MD, 1998.

The actual applications are full of charts, graphs, tables, and other forms of results. The winning companies are well on the way to "management by fact," and it is not surprising that they report their activities in fact-rich documents. The examiners expect this and often refuse to score any examination item highly that doesn't have convincing data to support a statement. One of the most common statements on a scored application is, "Lack of evidence to support claim of.…"

Another misconception about the scoring is a belief that the examiners and judges rely wholly on a total score in making their final decisions on applicants. This is not at all the case. The seven category scores are always highly visible to all examiners and judges, and individual category scores are discussed at length. It is highly unlikely that a company scoring poorly in any single category would ever be selected for an award.

The scores, individual categories and total, are mainly used in the early stages of the awards process. High-scoring applications are selected for the consensus review stage. High-scoring applications after consensus scoring are selected for site visits. After site visits, scores are *not* recalculated. The actual findings of the site-visit teams are submitted to the judges, and the judges get further information from the site-visit team leader or members. At this stage of judging, scores have become much less important and are rarely used. The site-visit teams concentrate a great deal of their activity on finding the evidence to support claims in the applications, verifying results, and examining supporting documents. These visits focus very much on results, not just approach or
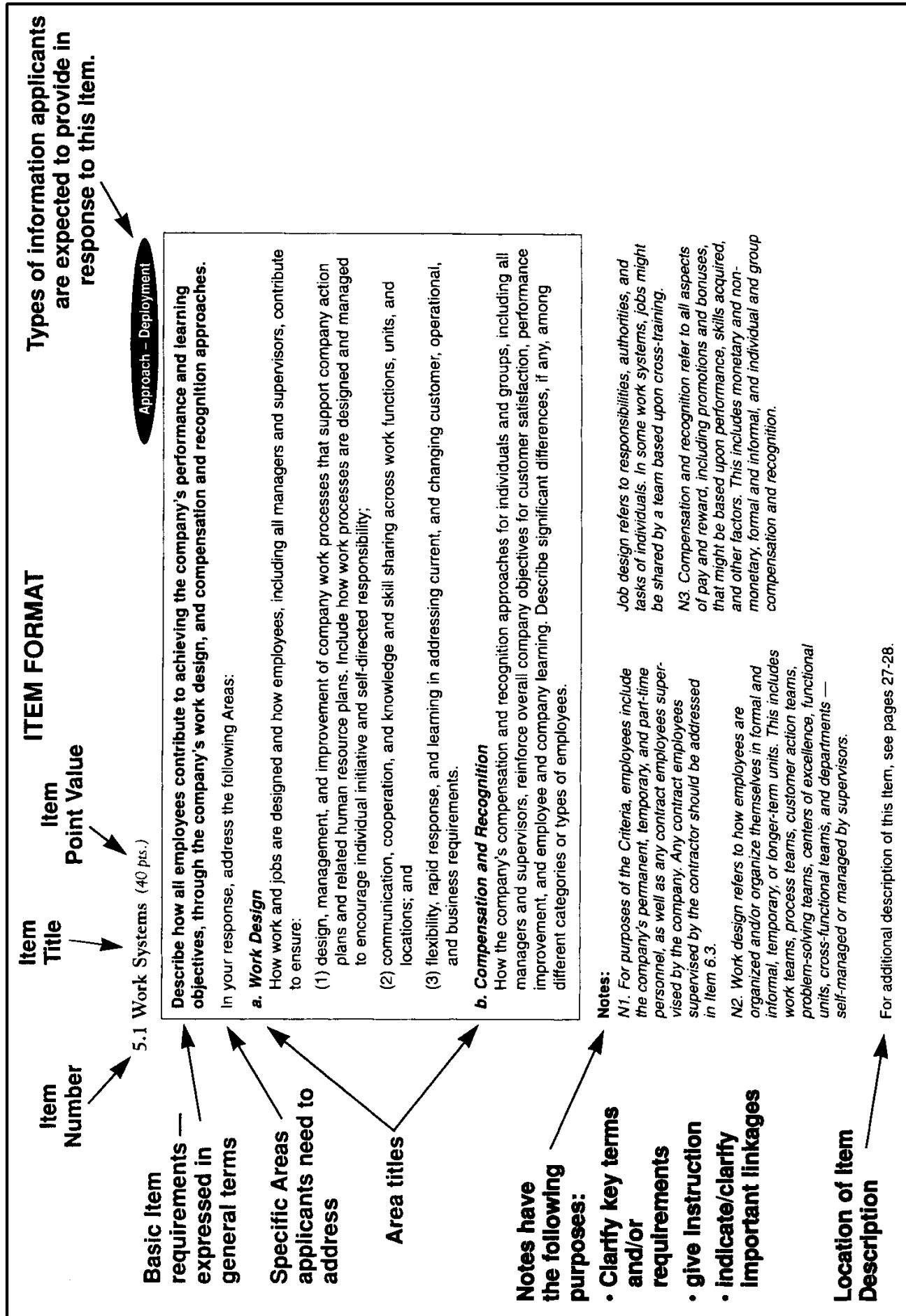
Types of information applicants are expected to provide in this Item.

ITEM FORMAT

Item Number | Item Title | Item Point Value

Approach – Deployment

5.1 **Work Systems** (40 pts.)

Describe how all employees contribute to achieving the company's performance and learning objectives, through the company's work design, and compensation and recognition approaches.

In your response, address the following Areas:

a. Work Design
How work and jobs are designed and how employees, including all managers and supervisors, contribute to ensure:

(1) design, management, and improvement of company work processes that support company action plans and related human resource plans. Include how work processes are designed and managed to encourage individual initiative and self-directed responsibility;

(2) communication, cooperation, and knowledge and skill sharing across work functions, units, and locations; and

(3) flexibility, rapid response, and learning in addressing current, and changing customer, operational, and business requirements.

b. Compensation and Recognition
How the company's compensation and recognition approaches for individuals and groups, including all managers and supervisors, reinforce overall company objectives for customer satisfaction, performance improvement, and employee and company learning. Describe significant differences, if any, among different categories or types of employees.

Notes:

N1. For purposes of the Criteria, employees include the company's permanent, temporary, and part-time personnel, as well as any contract employees supervised by the company. Any contract employees supervised by the contractor should be addressed in Item 6.3.

N2. Work design refers to how employees are organized and/or organize themselves in formal and informal, temporary, or longer-term units. This includes work teams, process teams, customer action teams, problem-solving teams, centers of excellence, functional units, cross-functional teams, and departments — self-managed or managed by supervisors.

Job design refers to responsibilities, authorities, and tasks of individuals. In some work systems, jobs might be shared by a team based upon cross-training.

N3. Compensation and recognition refer to all aspects of pay and reward, including promotions and bonuses, that might be based upon performance, skills acquired, and other factors. This includes monetary and non-monetary, formal and informal, and individual and group compensation and recognition.

For additional description of this Item, see pages 27-28.

Item Number

Basic Item requirements — expressed in general terms

Specific Areas applicants need to address

Area titles

Notes have the following purposes:
- Clarify key terms and/or requirements
- give Instruction
- indicate/clarify Important linkages

Location of Item Description

FIGURE 14.8   Example of areas to address. (*National Institute of Standards and Technology 1998, p. 37.*)

14.24

deployment. The focus is on whether the company's approach is *working* and is working across the company and across all functions. Examiners verify data, interview employees, and review actual operations and facilities.

During the site visit, examiners look for measurements of both internal and external quality. They look for measures of suppliers' quality levels. They interview employees and ascertain the results of the training, teamwork, and quality improvement processes. They look at customer satisfaction data, competitive evaluations, and benchmarks. They look for evidence of actual, sustained improvement and world-class performance.

Administration of the Malcolm Baldrige National Quality Award.

The Malcolm Baldrige National Quality Award is administered through a complex set of processes under the management of the U.S. Department of Commerce, Technology Administration, National Institute of Standards and Technology. Administration for the Award is provided by the American Society for Quality. Most of the actual work of reviewing and scoring applications, site visits, judging, and developing the management processes is done by several hundred volunteers from U.S. companies, universities, government, consultants, and other organizations. These volunteers perform several key roles.

The Board of Overseers is a small group of people who have established preeminence in quality management. For example, the recent Chair of the Board of Overseers has been Robert Galvin, the chairman of the Executive Committee of Motorola. Motorola was one of the first winning companies of the MBNQA. Quality management experts Armand V. Feigenbaum, William Golomski, and Joseph M. Juran have all served as members of the Board of Overseers.

The overseers are concerned mostly with questions of process. They ensure that proper processes for managing the MBNQA are in place, are working, and are continuously improved. They review recommendations by the judges as to process improvements, but the overseers are not involved in the actual evaluation and judging of the applicants.

Issues of concern for the overseers include number of awards, award categories, changes to the Act, and technology sharing and transfer based on lessons learned.

The Board of Examiners consists of over 200 persons selected according to expertise, experience, and peer recognition. They do not represent companies or organizations, but serve as volunteers for the common good. All members of the Board of Examiners receive 3 days of rigorous training using case studies, scoring exercises, and team-building sessions. They become a powerful network for quality improvement throughout the United States.

The Board of Examiners consists of three distinct groups: Judges, Senior Examiners, and Examiners. There are nine Judges. The Judges oversee the entire process of administering the Award, help select examiners, review the scored applications, select the organizations to receive site visits, and review the results of the site visits. They then decide which, if any, organizations to recommend for the Malcolm Baldrige National Quality Award.

The final decision for the awards is made by the Secretary of Commerce after further background evaluations of the recommended organizations. These further evaluations are intended solely to determine if an organization is facing environmental charges, Justice Department action, or other problems. If these concerns are substantial, the Secretary may remove the organization from the recommended list. The Secretary may not add any organization to the list and has no other influence on the awards process.

The Judges are involved in oversight at every stage of the MBNQA process but only get involved in the review of actual applications after many hours of work by the examiners. These evaluations, screenings, and site visits provide the foundation on which the award process is built.

There are approximately 20 to 30 Senior Examiners, and they play a crucial role. They are selected for their experience and expertise. Many have been examiners for several years or directly involved in winning organizations' quality management. They score applications and manage the consensus review process.

There are almost 200 Examiners. The Examiners score all the applications, perform site visits with the Senior Examiners, and provide input each year on how to improve the application guidelines, the scoring process, and the entire awards process.

The MBNQA process follows several, carefully defined steps. The first is the annual improvement of the criteria, the guidelines, and the entire awards process. The next step is the completion of the eligibility determination form by the applicant company. Applicants must have their eligibility approved prior to applying for the award. Each applicant then completes and files the application. The award applications then go through four stages of review:

Stage 1:   Independent review by at least five members of the Board of Examiners

Stage 2:   Consensus review and evaluation for applications that score well in Stage 1

Stage 3:   Site visits to applicants that score well in Stage 2

Stage 4:   Judge's review and recommendations

The scoring system used by the Board of Examiners is described in the application guidelines. It is based on three evaluation dimensions: (1) approach, (2) deployment, and (3) results. All examination items require applicants to furnish information relating to one or more of these dimensions. The Scoring Guidelines are reproduced as Figure 14.9.

Each year, after the recommendations for the winning companies are forwarded to the Secretary of Commerce, the Judges review the entire MBNQA process. Feedback is solicited from all members of the Board of Examiners, applicant companies, the Administrator of the award process (ASQ), the staff of the National Quality Award Office, and other interested parties. The suggestions for improvement are carefully considered, and each year a number of changes are made to the award criteria, the application guidelines, and the award process. This constant improvement is one of the greatest strengths of the Malcolm Baldrige National Quality Award.

THE EUROPEAN QUALITY AWARD

Conti (1993) presents a comprehensive view of a total quality system in *Building Total Quality*. In this outstanding text Conti uses the European Quality Award as the fundamental model for total quality and gives many expansions of this model tied to business performance.

Conti's view of a total quality system is well worth understanding. He breaks the system down into five first-level subdivisions: the role of management, corporate values/culture, infrastructure, involvement/use/role of human resources, and the adequacy/use of technical resources. These are shown in Figure 14.10.

Conti also suggests a further deployment of this model from the first-level criteria to the second-level criteria. He admits that the choice of criteria is more subjective at this level and based on experience. He suggests that when used by different companies and/or different market sectors it is essential to assign appropriate weights to the different criteria. In fact, some of the assigned weights might be zero for certain companies. Conti's second-level criteria are shown in Figure 14.11.

Conti was a leading contributor in developing the European Quality Award, so it comes as no surprise that his model is closely connected to the underlying model of this award.

The European Quality Award (EQA) shares many concepts and criteria elements with the Malcolm Baldrige National Quality Award, but the two awards differ in some important ways. Conti illustrates the differences clearly and openly discusses strengths and weaknesses of both approaches as well as compares them both with the Deming Application Prize.

The logical model of the EQA is quite clear (Figure 14.12). The first element is leadership which drives people management, policy and strategy, and resources. These, in turn, drive all processes which drive people satisfaction, customer satisfaction, and impact of society. These three drive business results.

One of the major differences between the Malcolm Baldrige National Quality Award and the European Quality Award is the emphasis the EQA puts on self-assessment. The EQA makes the principle of self-assessment an entry requirement for companies applying for the award. Conti (1997) stresses this in a more recent text, *Organizational Self-Assessment*.

A second difference between the EQA and the MBNQA, which Conti feels is a weakness in the EQA, is the apparent absence of the fundamental internal results category. Some people argue that

SCORE	RESULTS
0%	■ no results or poor results in areas reported
10% to 30%	■ early stages of developing trends; some improvements *and/or* early good performance levels in a few areas ■ results not reported for many to most areas of importance to the applicant's key business requirements
40% to 60%	■ improvement trends *and/or* good performance levels reported for many to most areas of importance to the applicant's key business requirements ■ no pattern of adverse trends *and/or* poor performance levels in areas of importance to the applicant's key business requirements ■ some trends *and/or* current performance levels — evaluated against relevant comparisons *and/or* benchmarks — show areas of strength *and/or* good to very good relative performance levels
70% to 90%	■ current performance is good to excellent in most areas of importance to the applicant's key business requirements ■ most improvement trends *and/or* performance levels are sustained ■ many to most trends *and/or* current performance levels — evaluated against relevant comparisons *and/or* benchmarks — show areas of leadership and very good relative performance levels
100%	■ current performance is excellent in most areas of importance to the applicant's key business requirements ■ excellent improvement trends *and/or* sustained excellent performance levels in most areas ■ strong evidence of industry and benchmark leadership demonstrated in many areas

SCORE	APPROACH/DEPLOYMENT
0%	■ no systematic approach evident; anecdotal information
10% to 30%	■ beginning of a systematic approach to the primary purposes of the Item ■ early stages of a transition from reacting to problems to a general improvement orientation ■ major gaps exist in deployment that would inhibit progress in achieving the primary purposes of the Item
40% to 60%	■ a sound, systematic approach, responsive to the primary purposes of the Item ■ a fact-based improvement process in place in key areas; more emphasis is placed on improvement than on reaction to problems ■ no major gaps in deployment, though some areas or work units may be in very early stages of deployment
70% to 90%	■ a sound, systematic approach, responsive to the overall purposes of the Item ■ a fact-based improvement process and organizational learning/sharing are key management tools; clear evidence of refinement and improved integration as a result of improvement cycles and analysis ■ approach is well-deployed, with no major gaps; deployment may vary in some areas or work units
100%	■ a sound, systematic approach, fully responsive to all the requirements of the Item ■ a very strong, fact-based improvement process and extensive organizational learning/sharing are key management tools; strong refinement and integration — backed by excellent analysis ■ approach is fully deployed without any significant weaknesses or gaps in any areas or work units

FIGURE 14.9 Baldrige scoring guidelines. *(National Institute of Standards and Technology 1998, p. 35.)*

14.27
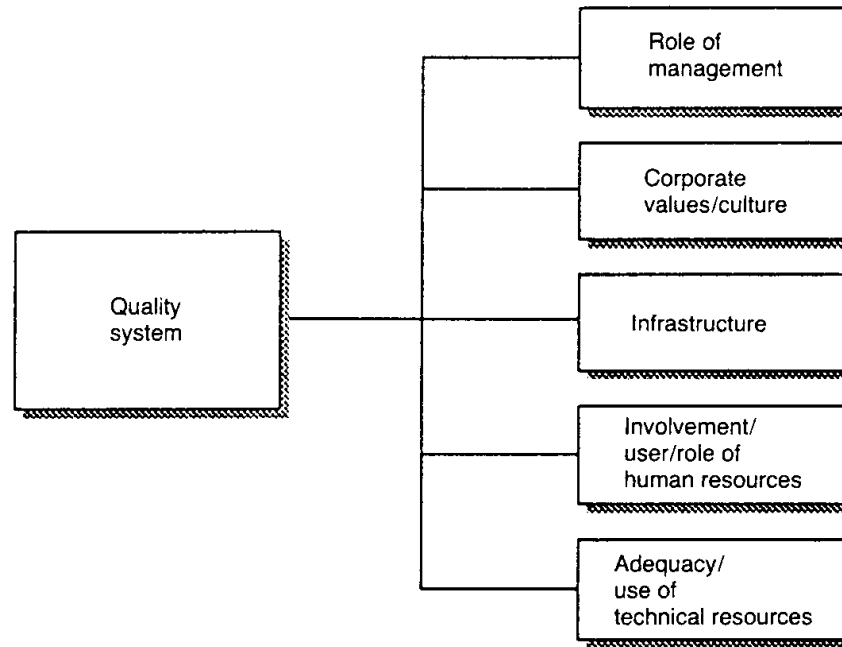
FIGURE 14.10   First-level deployment of a quality system. (*Conti 1993, p. 112.
Used with permission.*)

internal results are implicit in other categories, but Conti feels that "it is inadmissible that such an
important category should be absent or implicit in some other category." (Conti 1993, p. 289.)

Another difference between the MBNQA and EQA is the way the awards are administered. The
MBNQA is competitive; it is given to a maximum of two companies in each of three categories:
manufacturing, service, and small business. So far this has not been a problem, since the maximum
number of companies has never been reached. The EQA is essentially noncompetitive, every com-
pany that reaches the pass mark receives a "prize." The Award is given to the best prize winner. In
some ways this makes the EQA even more competitive, since companies have a great desire to win
the award not just a "prize."

THE DEMING APPLICATION PRIZE

Another major contribution to the development of total quality has been the Union of Japanese
Scientists and Engineers' Deming Application Prize. In his definitive book, *Companywide
Quality Control,* Kondo describes the creation and evolution of the Deming Prize (Kondo 1995,
pp. 37–42):

> In recognition of Deming's friendship and contributions to Japan, the Deming Prize was established
> in 1951 at JUSE's suggestion to encourage the development of QC in Japan. The prizes were originally
> funded with Deming's generous gift of the royalties from transcripts of his eight-day QC course lectures
> and the Japanese translation of his book, *Some Theory of Sampling,* along with other donations.

There are two types of Deming Prize—the Deming Prize for individuals and the Deming Application
Prize for companies and divisions (Kondo 1995, p. 38).

> Deming Application Prizes are awarded to companies or operating divisions that have achieved
> outstanding results through the skillful application of CWQC (companywide quality control) based on
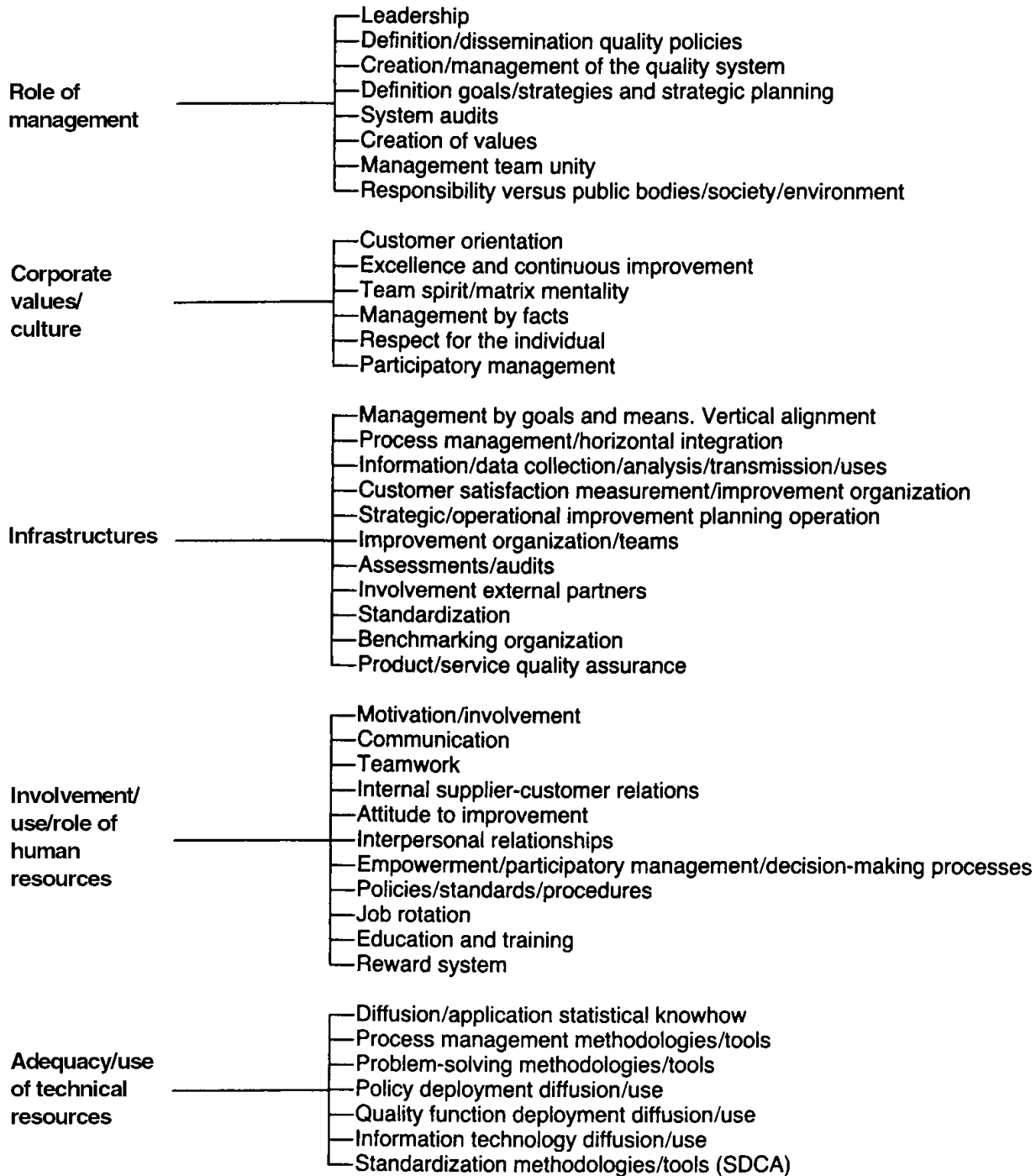
Role of management
- Leadership
- Definition/dissemination quality policies
- Creation/management of the quality system
- Definition goals/strategies and strategic planning
- System audits
- Creation of values
- Management team unity
- Responsibility versus public bodies/society/environment

Corporate values/ culture
- Customer orientation
- Excellence and continuous improvement
- Team spirit/matrix mentality
- Management by facts
- Respect for the individual
- Participatory management

Infrastructures
- Management by goals and means. Vertical alignment
- Process management/horizontal integration
- Information/data collection/analysis/transmission/uses
- Customer satisfaction measurement/improvement organization
- Strategic/operational improvement planning operation
- Improvement organization/teams
- Assessments/audits
- Involvement external partners
- Standardization
- Benchmarking organization
- Product/service quality assurance

Involvement/ use/role of human resources
- Motivation/involvement
- Communication
- Teamwork
- Internal supplier-customer relations
- Attitude to improvement
- Interpersonal relationships
- Empowerment/participatory management/decision-making processes
- Policies/standards/procedures
- Job rotation
- Education and training
- Reward system

Adequacy/use of technical resources
- Diffusion/application statistical knowhow
- Process management methodologies/tools
- Problem-solving methodologies/tools
- Policy deployment diffusion/use
- Quality function deployment diffusion/use
- Information technology diffusion/use
- Standardization methodologies/tools (SDCA)

FIGURE 14.11 Second-level deployment of a quality system. (*Conti 1993, p. 113. Used with permission.*)

statistical methods and are considered likely to continue to do so in the future, where CWQC is defined as "the activity of economically designing, producing, and supplying products and services of the quality demanded by customers, based on customer-focused principles and with full consideration of the public welfare."

In over the 40-year existence of the Deming Application Prize, there have been many modifications and improvements to the prize criteria and the administration of the prize. The Deming Application Prize is not competitive; every company whose application is accepted may win. The
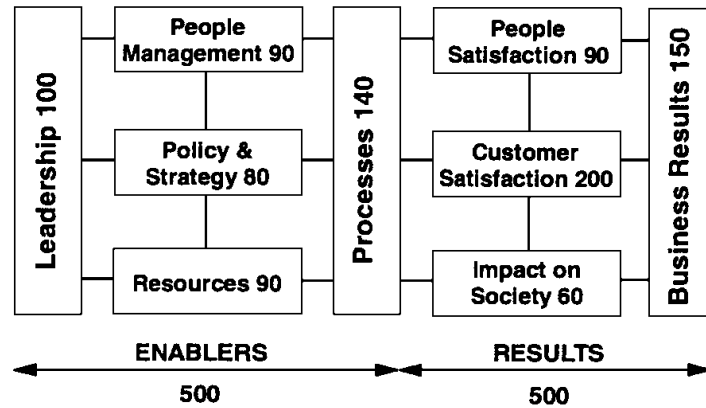
FIGURE 14.12   European Quality Award: the scoring process.
(*Leadership for the Quality Century, Juran Institute, Inc., Wilton, CT. Used with permission.*)

examiners are selected by JUSE from a small group of scholars and other distinguished experts associated with not-for-profit organizations, who share a deeply rooted and basically uniform approach to quality management (Conti 1993, p. 286).

Conti gives a simple chart illustrating the first-level deployment and an example of second-level deployment for the assessment model of the Deming Application Prize. This model is given as Figure 14.13.

There are several differences between the Malcolm Baldrige National Quality Award and the Deming Application Prize. There is no limit to the number of companies that may receive a Deming Application Prize in any one year. There is a stronger emphasis on the use of statistical methods than in the Baldrige Award. The company decides itself when it is to receive an objective assessment of whether its activities have reached the level capable of passing the Deming Application Prize examination. Usually the company engages a team of consultants from JUSE to provide on-going consulting support during the 4 or 5 years preceding the official examination.

Kondo points out that one of the main differences between the Deming Application Prize and the Malcolm Baldrige National Quality Award is that the checklist of items applicants must satisfy to win a Baldrige Award is far more detailed, extending to 23 pages. Due to interest from around the world, the Deming Prize Committee created new regulations in 1984 making it possible for countries outside Japan to apply. In 1989 an American electric utility, Florida Power & Light, became the first overseas company to win. In 1991 Philips Taiwan became the second winner of the Deming Application Prize for Overseas Companies, and in 1994 the AT&T Power Systems division became the third.

COMPARISON OF NATIONAL/INTERNATIONAL QUALITY AWARDS AND INTERNATIONAL STANDARDS

Over the past few years there have been numerous attempts to compare the ISO 9000 series of standards with the Malcolm Baldrige National Quality Award, the Deming Application Prize, and the European Quality Award. Conti (1993, p. 283) provides one comparison (Figure 14.14). The ISO 9000 series of standards is covered in depth in Section 11.

In Conti's chart (Figure 14.14), the ISO 9000 series of standards provides a way of assessment and certification for the excellence of a quality system that is at the far left of the x axis. That is, the ISO system focuses on products and is the least comprehensive of the systems. It is also at the bottom of the *y* axis, indicating no assessment of excellence of results but just of system.

Conti sees the MBNQA, the Deming Application Prize, and the EQA as roughly equal in their focus on comprehensiveness of the quality system but the EQA as somewhat more focused on
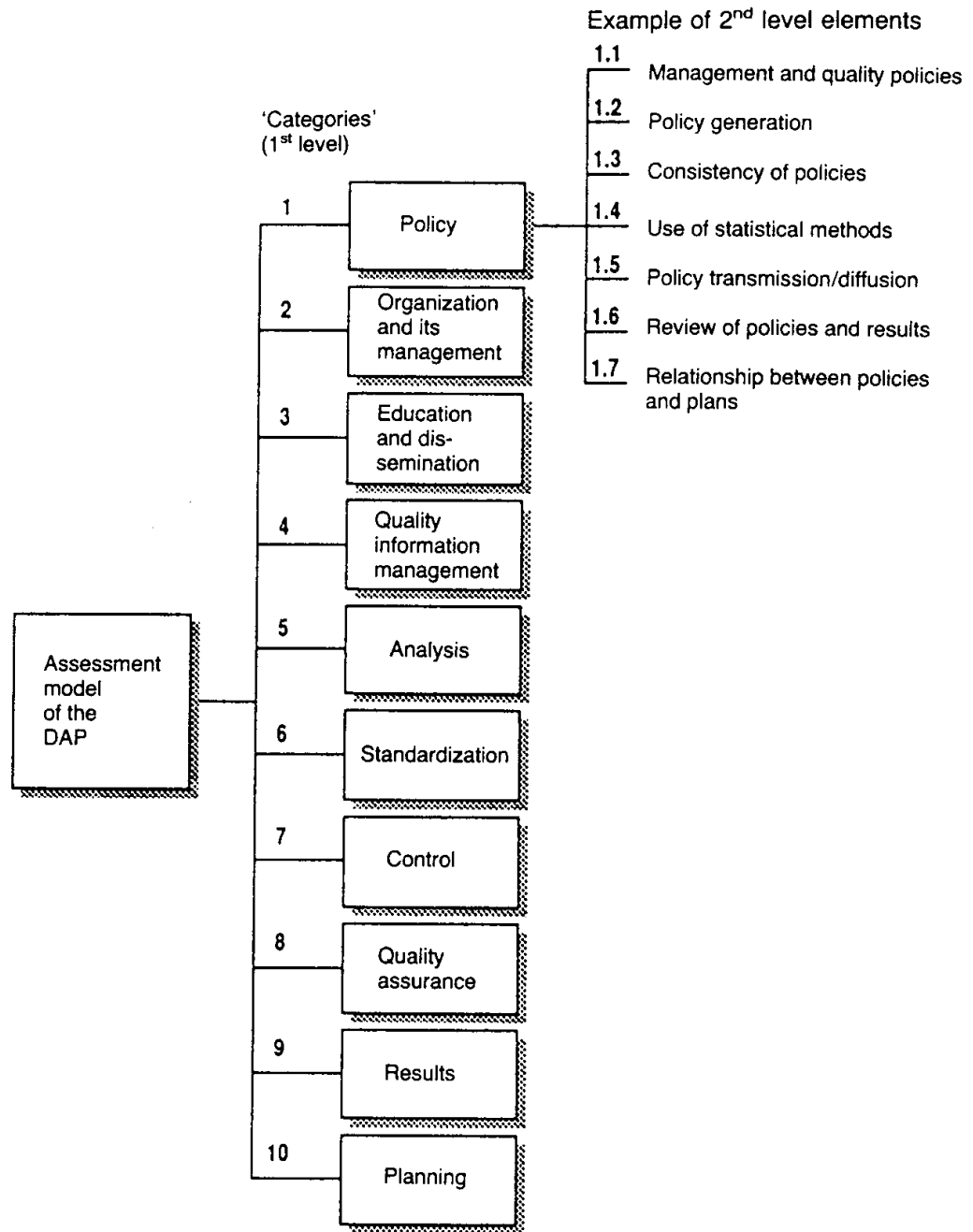
Example of 2ⁿᵈ level elements

1.1 Management and quality policies

1.2 Policy generation

1.3 Consistency of policies

1.4 Use of statistical methods

1.5 Policy transmission/diffusion

1.6 Review of policies and results

1.7 Relationship between policies and plans

'Categories'
(1ˢᵗ level)

1 Policy

2 Organization and its management

3 Education and dis-semination

4 Quality information management

5 Analysis

6 Standardization

7 Control

8 Quality assurance

9 Results

10 Planning

Assessment model of the DAP

FIGURE 14.13 The Deming Application Prize. (*Conti 1993, p. 281. Used with permission.*)

results. The MBNQA has changed since Conti's comparisons, and it is now more focused on results, perhaps equal to the EQA.

RE-ENGINEERING, SIX SIGMA, AND OTHER EXTENSIONS OF TOTAL QUALITY MANAGEMENT

In the past few years there have been many redefinitions of total quality management. TQM has become an umbrella term for many different collections of concepts, methods, and tools. As new concepts are created, they are often added as extensions to the basic collection. Sometimes the creators
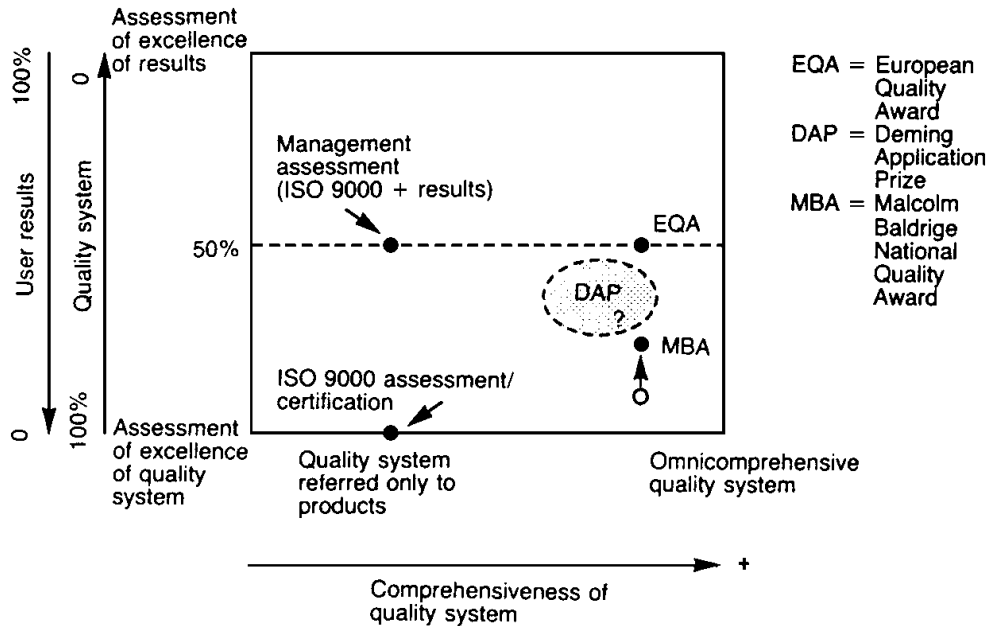
FIGURE 14.14   Comparison of awards, assessments, and ISO. (*Conti 1993, p. 283. Used with permission.*)

of these ideas and tools attempt to differentiate their ideas from TQM and energetically stake a separate place for their efforts. But most of the leading companies continuously integrate the new methods with the older successful methods and discard what is not working along the way.

A few years ago a great effort was made to stake a claim that re-engineering was somehow different from other methods considered part of TQM. Some companies actually created new departments of re-engineering separate from the quality departments or continuous improvement departments. Soon these efforts were merged. In Section 6, Process Management, the history of business process management, business process quality improvement, and re-engineering are covered thoroughly.

More recently there has been an emphasis on "six sigma" and "black belt" quality training. The concept of six sigma was introduced in the 1980s by Motorola in its efforts to reduce the defects in manufactured products to only a few parts per million. Later, Motorola extended the six sigma concept to business processes and service operations. Motorola allowed for a process average drift by as much as 1.5 standard deviations, so their term of six sigma actually sets the targets at 4.5 standard deviations—or 3.4 parts/million.

As other companies have taken ideas from Motorola and other leading companies and added their own variations, six sigma has come to be "a programme aimed at the near-elimination of defects from every product, process and transaction" (Tomkins 1997, p. 22). Six sigma has thus become a disciplined, quantitative approach for improving operations in all types of industries and business functions. The six sigma initiatives may sound quite familiar to many leading companies with successful total quality management systems but often sound quite new to those companies who have just dabbled in quality management in the past.

The basic steps of the six sigma process are quite similar to the quality improvement processes and quality control processes introduced in Section 5, Quality Improvement, and Section 4, Quality Control. The five basic steps are usually explained as define, measure, analyze, improve, and control. The implementation stresses leadership at the highest levels of the company. For many companies this has been the CEO, such as Jack Welch at General Electric, Bob Galvin at Motorola, and Larry Bossidy at Allied Signal. The implementation is then cascaded throughout every level of management, and clear responsibilities are understood (Hoerl 1998, p. 36).

The main focus of six sigma, like many other quality initiatives, is on cost and waste reduction, yield improvements, capacity improvements, and cycle-time reductions. Heavy emphasis is put on

satisfying customer needs. Organizations try to estimate the financial impact of each operation. These companies also establish clear performance metrics for each improvement in costs, quality, yields, and capacity improvements. Financial figures are absolutely required. The projects undertaken are usually substantial with improvements commonly in the $50,000 to $100,000 range.

Another difference in the six sigma initiatives and many total quality management programs is the assignment of full-time staff. The team leaders and facilitators (often called black belts and master black belts) are chosen carefully and work 50 to 100 percent of their time on the improvement projects. The training for these people is also extensive, usually 4 or 5 weeks of intensive, highly quantitative training (Hoerl 1998, p. 36). Some companies have actually implemented training programs lasting up to 6 months for their new black belts.

Over the past few years many other concepts, methods, and tools have become part of the overall total quality management philosophy. Many of these concepts have become part of this handbook. For thousands of years organizations have tried to learn the secrets of others' successes, but in the past few years benchmarking has become a frequently used (and sometimes misused) management tool. Benchmarking is covered in Section 12. Quality assurance systems have been standardized and third-party assessments have become commonplace. These developments are covered in Section 11. Organizations have extended their quality systems into their suppliers, operations creating true customer/supplier relationships. These extensions are covered in Section 21. Customer service, customer satisfaction, and customer loyalty have become critical elements in all quality systems. Many of these new developments are discussed in Section 25. New methods and tools have been developed for extending quality management to information systems. These are covered in Section 34.

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